



UGANDA PROTECTORATE.

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ANNUAL REPORT  
ON THE  
DEPARTMENT OF  
AGRICULTURE  
(PART II.)

FOR THE  
*Year ended 30th June, 1938.*

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PRICE : SHS. 4/-.

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Published by Command of His Excellency the Governor.

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ENTEBBE:  
PRINTED BY THE GOVERNMENT PRINTER, UGANDA.  
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## CONTENTS.

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|                                                             | <i>Page.</i> |
|-------------------------------------------------------------|--------------|
| Introduction .. .. .                                        | 5-6          |
| Reports of Entomological Section .. .. .                    | 7-19         |
| (i) Report of the Senior Entomologist, Kampala              | 7-9          |
| (ii) Report of the Entomologist, Kampala ..                 | 9-10         |
| (iii) Report of the Entomologist, Serere ..                 | 10-19        |
| Report of the Senior Plant Pathologist .. .. .              | 20-25        |
| Report of the Chemical Section .. .. .                      | 26-41        |
| Reports of the Botanical Section .. .. .                    | 42-82        |
| (i) Report of the Senior Botanist, Bukalasa ..              | 42-56        |
| (ii) Report of the Botanist, Serere .. .. .                 | 56-74        |
| (iii) Report of the Botanist, Kampala .. .. .               | 74-79        |
| (iv) Report on the Botanic Gardens, Entebbe ..              | 79-82        |
| Report on the Provincial Programmes of Experimental work .. | 83-99        |



## INTRODUCTION.

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Part II of the Annual Report gives an account of the activities of the staff of the Laboratories Division of the Department and is a record of the experimental work carried out by them and by officers of the Field Division during the crop year ending June 30th, 1938.

The reports received from the Serere Experiment Station once again record some interesting developments. Varietal resistance in cotton to Jassid attack has been accepted as a fact for some time, but has recently been established from formal data. The relation between Jassid damage and yield has also been established, but shows, as foreshadowed in my Introduction last year, that Jassids are not likely to cause serious crop failure in Uganda. *Lygus* remains the most serious cotton pest in the Serere area. Here also we have an indication, which will have to be confirmed, of varietal susceptibility and also some important conclusions concerning the bearing of millet crops on this pest.

Serere distributed its third, and most promising U.4 strain (S.P.84) to the first stage of native cultivation. The cotton selection position on this station has now been greatly strengthened by the addition of promising strains other than U.4. A return has been made to the old Nyasaland Upland strain N.17 for new material, and another Nyasaland Upland strain (S.P.102) put up a fine record in the variety trial in Busoga.

At the Bukalasa Experiment Station, Wilt is proving a serious limitation in the cotton programme and constitutes a problem which will demand the fullest attention in the elephant grass area. In addition to definite indications of varietal susceptibility, it appears that acclimatization may play an important part in confirming tolerance on introduced and newly bred strains. The Wilt problem and a season of exceptionally heavy Black Arm infection were serious hindrances to the work of lint improvement.

There is an interesting record of work on *Arabica* coffee at Bugusege, and on *Robusta* coffee at Bukalasa. A valuable collection of *Robusta* and *Nganda* progenies has been built up at the Kawanda Experiment Station.

The ground treatment experiments on both species of coffee indicate the great value of mulching with banana leaves and elephant grass, and in the case of *Robusta* a large response to dressings of cotton seed has been demonstrated. The use of cotton seed and cotton seed meal is further discussed in the Senior Chemist's report. It has not yet been possible to show that small dressings of these fertilising materials have a useful effect and as in the case of farm yard manure it seems that applications at least as heavy as those used in European agriculture are needed.



The new Experiment Station and Laboratories at Kawanda have started work at the time of writing. The land has been contour banked and the greatest effort is being made to bring our experience, and the experience of others, to bear on the problem of soil conservation. In the contiguous segregated area the new cotton strain B.P.52 was issued for native cultivation.

I would take this opportunity of expressing my appreciation of the valuable contributions to the Entomological section made by Mr. A. M. Gwynn, Entomologist, who has resigned from the service.

A. S. RICHARDSON,  
*Acting Director of Agriculture.*



## REPORTS OF THE ENTOMOLOGICAL SECTION.

### (i) REPORT OF THE SENIOR ENTOMOLOGIST, KAMPALA.

#### Locusts.

The outstanding features during the period were: the spread of the red locust into the Eastern Province where this species had not occurred since 1918; the development of two generations of hoppers of this species; and the immigration and breeding of the tropical migratory locust, the swarm phase of which had been absent from Uganda for three years. The two species are dealt with separately below.

2. Monthly summaries were compiled from district reports and sent to Governments of adjoining territories, the Imperial Institute of Entomology and the local press; during the last third of the period local administrative and agricultural officers also were supplied with the summaries. The usual maps shewing distribution and activities of locusts were prepared.

3. While damage to crops (entirely by *Nomadacris*) was generally slight, intense local damage to cotton, especially later sowings, was caused late in 1937 in eastern Busoga; in this area 17,000 plots were affected, the loss being computed at 5% of the crop of these plots. Other crops damaged comprised banana, beans, groundnut, maize, and millets (*Eleusine* and *Sorghum*).

4. Action against locusts was undertaken by the local inhabitants. The measures adopted included digging or ploughing of egg-areas, and beating and ring-burning against hoppers.

*Nomadacris*.—During July and August flights were restricted almost entirely to districts in the west—Bunyoro, Toro, Ankole, and Kigezi.

5. In September, a radical change occurred, the infestation spreading over the Eastern Province south of Latitude 1°N. The districts affected comprised Mengo, Busoga, Budama and to a less extent the southern parts of Bugwere and Bugishu. These swarms were mature and they laid eggs over considerable areas during the latter half of the month and October. The first hoppers appeared in October and their survivors reached the winged stage late in December, the remainder developing wings in January.

6. A tendency to westerly movement of fliers developed in January and some further movement in this direction continued during February; on reaching areas of Mengo District around Longitude 32°E. several swarms proceeded north and over the border into the Sudan. The swarms remaining in the Mengo-Eastern Province area (of which there were only ten records in March) moved eastwards in April, and broke up into smaller swarms which persisted with comparatively little movement

during May in areas bordering the Victoria Nile, around Lake Kioga, and in the Mpologoma River basin. The protracted hot dry season hastened maturity of the locusts.

7. Egg-laying commenced in May and continued during June, hoppers appearing during the latter month in some of the more eastern districts, including Teso.

8. In the western districts mentioned in the opening paragraph, locust activity was considerably increased by influx of swarms from the south during the period May–July. A reduction in the number of swarms became evident in September, and observations continued to diminish in frequency until only six were recorded during June in Toro and Ankole.

9. Breeding in these western districts was very restricted; eggs were laid over small areas in southern Ankole (October), in western and southern Toro (December), and over a tiny area in Kigezi (March).

*Locusta*.—West Nile District was the only area affected by this species which entered from the Belgian Congo.

10. In January a swarm arrived and settled just over the boundary near Arua, returning next day to the west. Two large swarms appeared in the same locality in February; later that month they flew north-east over West Madi into the Sudan. In March two swarms entered from the south and after a short stay returned to Belgian territory. Several partially mature swarms, flying north-east, passed into the district west of Arua; eggs were laid during April in rather widespread areas mainly in the north, portions of the swarms continuing flight into the Sudan. Hatching occurred during May and the resultant hopper bands were small.

### Beekkeeping.

11. Demonstrations of extraction and preparation of wax were given by the African Instructor over a period of ten months at Native Administrative centres in Mengo, West Nile and Gulu Districts.

12. Purchases of beeswax in northern and eastern Mengo on behalf of Government amounted to 309 lbs. Attempts were made to find buyers in Kampala for the honey produced in Bugerere, but little interest in the produce was shown; the beekeepers of that county were discouraged by the relatively large amounts of honey produced being unsaleable.

### Advisory.

13. As in previous years, a considerable number of requests for information and assistance were dealt with. These included insects on plantation and food crops, fruit and garden plants, timber trees, and in houses. A few instances of bee swarms and nests causing nuisances in buildings received attention.

### Miscellaneous.

*Publication*.—"Factors Affecting the Attack of Sucking Insects on Cotton" by A. M. Gwynn. *East African Agricultural Journal*, III, 1937–38.



*Agricultural Show.*—Six cases of crop pests, and samples of beeswax, were prepared for exhibition at Nakuru.

*Plant Protection.*—Regulations were drafted to make local legislation uniform with that of Kenya. During the year 199 packages of imported plants were inspected and 21 packages fumigated for export.

H. HARGREAVES,  
*Senior Entomologist.*

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## (ii) REPORT OF THE ENTOMOLOGIST, KAMPALA.

### Pink Bollworm.

During the 1937–38 cotton season, Pink Bollworm spread almost throughout Busoga and Budama. At the end of the season it was present in most cotton plots near the Kenya border in Budama. In Teso, extensive spreading took place in Kasilo and Serere Counties from the Bugondo area, but the insect was not found east of the Agu swamp, which appears to have checked its eastward spread temporarily. It is expected that, during the 1938–39 season, the insect will spread through Soroti County to Usuku County, and will reach south-eastern Teso and Bugwere either by crossing the Agu swamp or by spreading northwards from Busoga or Budama.

2. It was again concluded that no serious damage by this pest is likely to occur, provided that the control measures already advocated are rigidly enforced. In certain areas, however, the destruction of the old plants at the end of the 1937–38 season left much to be desired and it is likely that in these areas Pink Bollworm will appear early in the next season and will do considerable damage which could have been avoided. It is now evident that a single plot in which the old plants have not been efficiently destroyed can, in the following season, cause a wide area of country to be infested.

3. Investigations in Kasilo country in March and April, 1938, led to the conclusion that almost all larvae in that area pupate when full grown, even at the end of the season, and that the resting stage is an extremely rare and abnormal occurrence. This is fortunate, but it is important only if the old plants are completely destroyed at the scheduled time. It is not yet safe to assume that the resting stage will be a rare occurrence in all parts of Teso, and developments in certain parts, such as Usuku, must be watched carefully in future seasons. It must be remembered that although, in all probability, no district of Uganda is hot and dry enough for the occurrence of the resting stage on a large scale, there is an intermediate condition in which larvae can feed and grow extremely slowly in ripe seed or other tissues on old or nearly dead plants.



### Antestia.

4. On return from leave in February, 1938, an intensive study of *Antestia* was commenced.

5. After a general survey of the problem at Kampala, a month was spent in the Mabira Forest coffee area, where *Antestia* is no longer a serious pest, investigating the ecology of the insect. Detailed studies were made of the whole insect fauna of coffee trees for comparison later with the fauna of areas where *Antestia* is doing serious damage, and special attention was paid to the parasites of the egg and adult stages of the bug. Much interesting (and possibly useful) information was obtained in the Mabira area, but at the present early stage in the investigation a detailed report can serve no useful purpose. The programme drawn up for 1938-39 includes lengthy visits to the coffee areas of Bugishu and of Ankole and Kigezi, where inexpensive control measures are urgently required. The problem in these areas is of a very special nature since the coffee is grown entirely by Africans, which circumstance limits possibilities of control to biological methods.

6. Tests of *Tephrosia Vogellii* leaves, both as fine powder (in closed receptacles) and as extract in kerosene (1 lb. to 1 gallon on coffee trees under cloth cover) indicated that the plant was of no value for control of *Antestia*.

T. H. C. TAYLOR,  
*Entomologist.*

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### (iii) REPORT OF THE ENTOMOLOGIST, SERERE.

#### Lygus.

*Seasonal Incidence.*—The usual heavy infestation occurred on early-sown cotton at Serere and elsewhere in Teso District. On Serere Experiment Farm the influx of adult bugs to cotton began early in June, and April-sown cotton, which until then had been practically free from the pest, became very heavily infested. April and May cotton remained heavily infested throughout July and the first part of August, but about August 20th, a slight decrease in intensity of leaf damage began to be noticeable, and by the end of the month a distinct improvement had taken place on the Experiment Farm and elsewhere in the neighbourhood. After this the outbreak declined steadily till by the end of October it was negligible. As usual, July-sown cotton suffered relatively little. The outbreak on parts of the Experiment Farm was much worse than during the preceding season, and may in fact be regarded as an example of the maximum damage likely to be inflicted by this pest. On the other hand the infestation on the Main Increase Farm was appreciably less than that of the previous season.

2. *Experimental Work.*—During the first part of the season attention was directed mainly to the question of the origin of the infestation on cotton. Later on, when it became evident that there were considerable

differences in susceptibility between the different varieties in the Serere variety trials, the study of these differences was the chief problem examined. The results of this work are included in the report summarised below. In addition, the observation on the Cotton-Groundnut Interplanting Trial described in the next paragraph may be recorded.

3. *Effect of Plant Growth on Lygus Infestation.*—It has always been evident that the more luxuriant plants suffered most from *Lygus*, while plants making poor growth showed little damage. This was very well illustrated by the Cotton-Groundnut Interplanting Trial at Serere in 1937. In this experiment the cotton was planted on three different dates, viz., a fortnight before, at the same time as, and a fortnight after the groundnuts. In all cases growth was severely checked in the plots interplanted with groundnuts as compared with the control plots. These interplanted plots also showed much less *Lygus* leaf-damage, and this observation was supported by the result of population samples taken on different dates.

#### 4. *Cotton-Groundnut Interplanting Trial:*

AVERAGE NUMBER OF ADULT *Lygus* NETTED IN 50 STROKES.

| Sowing date           | .. | .. | April 7th | April 21st | May 5th (a) | May 5th (b) |
|-----------------------|----|----|-----------|------------|-------------|-------------|
| Date sampled          | .. | .. | 18-6-37   | 18-6-37    | 18-6-37     | 2-7-37      |
| Cotton alone          | .. | .. | 7.2       | 10.8       | 5.0         | 12.6        |
| Cotton and groundnuts | .. | .. | 2.1       | 4.2        | 0.2         | 4.0         |

It is not suggested that the difference in *Lygus* infestation would normally be sufficient to compensate for the depressing effect of the interplanted crop on yield.

5. *Reports.*—A detailed report has been prepared, for future reference, embodying the results of the past three seasons' work on differences in varietal susceptibility to *Lygus*, and on the origin of the infestation on cotton, including a full account of the technique employed. These have been the two main questions to receive attention during this period. The main conclusions may be summarised as follows:—

(i) *Varietal Susceptibility.*—All the accumulated data bearing on this question were collected and examined. Owing to the difficulties of estimating damage and bug population, few results which could be regarded as statistically significant were obtained. Nevertheless, it is considered that these results, taken together, plainly indicate consistent differences between varieties in susceptibility to *Lygus*. Representatives of the S.P.14 (S.P.92, etc.) group of the U.4.4.2 derivatives appear distinctly more susceptible than most other strains. The Nariama group and S.P.90, varieties with a glabrous, succulent type of leaf (differing in this respect from the other varieties considered) seem to be slightly less susceptible than most; however, these varieties are the most susceptible to Jassid and *Helopeltis*. S.P.84 also tends to show relatively low susceptibility. S.P.102 appears to be distinctly less susceptible than any other variety examined.

(ii) *The Value of Low-Susceptibility*.—The value of moderate differences in susceptibility is debatable, but the writer considers that, until more is known about the subject, such differences should not be disregarded in judging the merits of different varieties. The question is discussed by the writer in "A General Review of the Pests of Cotton in Uganda", submitted to the Cotton Conference at Kampala in November, 1937.

(iii) *The Origin of Infestation*.—*Lygus* outbreaks on cotton are due to the invasion of the crop by a large population of adult bugs. The estimation of the size of the immigrant population is difficult, but it can be shown that at the peak of a fairly heavy infestation it is at least 3,000 to 4,000 per acre; this is a conservative estimate, and the true figure is probably very much larger. This immigration does not begin till early in June, and there is a good deal of circumstantial evidence to indicate that this first movement is mainly, if not almost entirely, derived from the grain crops (*Eleusine* and *Sorghum*) which are harvested at this time, and which are known to harbour a very large *Lygus* population in their later stages. An extensive survey has been made of the Capsid fauna of these two crops as well as of cotton. The population of the former appears to be built up from a relatively small number of bugs which find their way to them when the grain begins to swell (so far as is known, *Lygus* on these millets feeds only on the unripe grain). *Lygus* is also known to breed on a number of other hosts, but in none of these cases are large populations involved, and it is believed that its occurrence on many of these hosts is also a result of the dispersal from the grain fields.

### **Helopeltis.**

6. *Helopeltis* damage at Serere was again entirely negligible. Elsewhere it was in most cases uncommon during the early part of the season, though occasional attacked plants could generally be found on searching. On the occasion of Mr. Maxwell-Darling's visit at the end of September an attempt was made to locate any severe outbreaks which might exist, but the only ones it was possible to find were at Chiawante in S. Lango (the bug at this time appeared to be more prevalent in Lango than elsewhere) and on the Katakwe Variety Trial. Later in the season it became more common, and a number of late infestations were seen; this was usually too late to do any damage (except sometimes a little caused by the premature splitting of punctured bolls) as only the tops of the plants had been attacked, at a time when growth had almost ceased. Infestations of this sort were seen in the Variety Trials at Bulopa, Bugaya, Vukula, and Kibale. An extensive outbreak was reported at Budaka (Bugwere) in January, many of the plots being very badly damaged.

7. At least a little damage was noticed on each of the three Cotton-Groundnut Interplanting Trials seen by the writer; as there is no reason to suppose that there is any direct connection between *Helopeltis* and



groundnuts, this may have been because of the early date on which these trials were planted.

*District Variety Trials.*—Counts of the number of attacked plants were done on all trials where there was an appreciable infestation. Owing to the very uneven distribution of the infestation on most trials, it was considered better to compare the geometric means, instead of the arithmetic means, of the different varieties. This is done by using  $\log(n+1)$  ( $n$  = the number of attacked plants in each plot) instead of  $n$  in analysing the results<sup>1</sup>. The results were analysed by both methods; no significant results were obtained when the simple plot totals ( $n$ ) were used, but the following results were obtained by the use of  $\log(n+1)$ . The figures quoted are the geometric means of the number of attacked plants per plot in each case.

(a) FOUR TRIALS PLANTED WITH SERERE VARIETIES.

|                   |    |    | Local. | S.P.20 | S.P.84 | S.P.90 | Level of significance. |
|-------------------|----|----|--------|--------|--------|--------|------------------------|
| Aduku             | .. | .. | 3.9    | 1.0    | 2.8    | 3.1    | Nil                    |
| Katakwe           | .. | .. | 32.2   | 14.8   | 25.8   | 59.0   | $P < .01$              |
| Vukula            | .. | .. | 15.5   | 7.4    | 5.0    | 10.7   | Nil                    |
| Bugaya            | .. | .. | 6.0    | 6.6    | 4.5    | 5.6    | Nil                    |
| Combined analysis | .. |    | 10.7   | 5.7    | 6.6    | 11.8   | $P < .05$              |

The significant differences were:—

Katakwe: S.P.90 > S.P.84 = S.P.20.

Local > S.P.20.

Combined analysis: S.P.90 = Local > S.P.20.

S.P.84: no significant difference.

(b) BUSOGA TRIALS: BUKALASA SERIES.

|                   |    |    | N.17 | S.P.102 | B.P.52 | M.1  | Level of significance. |
|-------------------|----|----|------|---------|--------|------|------------------------|
| Bulopa            | .. | .. | 1.2  | 1.2     | 6.0    | 0.6  |                        |
| Bugaya            | .. | .. | 9.4  | 5.4     | 10.7   | 8.3  |                        |
| Vukula            | .. | .. | 6.4  | 2.6     | 10.9   | 14.5 |                        |
| Combined analysis | .. |    | 4.5  | 2.7     | 8.9    | 5.1  | $P < .05$              |

Significant differences:—

B.P.52 > N.17 = S.P.102.

M.1: No significant difference.

NOTE.—Analysis by logarithmic transformation.

8. In all cases the infestation was a late one, lesions occurring mainly on sympodia and on terminal shoots; comparing these results with those for the previous season, it appears that in these circumstances differences in varietal susceptibility are not so marked as in the case of earlier infestations. Nevertheless the order of susceptibility, as shown by the variety means is much as might be expected. The high susceptibility of S.P.90 was not unexpected, as by its glabrous, rather succulent

(1) C. B. Williams: "The use of Logarithms in the Interpretation of certain entomological Problems". *Ann. Appl. Biology* 24, No. 2, pp. 404-414. May, 1937.

type of growth it recalls S.P.88, the most susceptible variety in the preceding season.

### Jassids.

#### A. *Counts on Variety Trials.*

9. A feature of the Jassid infestation on the Variety Trials during the 1937-38 season was the presence in these trials of S.P.90, probably the most Jassid-susceptible variety which has been tried out at Serere during recent years. At certain centres this may have caused the general level of infestation to be higher than would otherwise have been the case.

10. Infestation on the Experiment Farm at Serere, though not heavy, was much above that in the previous two seasons, and on a few plots of July-sown S.P.90 averaged over 100 nymphs per 50 leaves in October and November. These plots showed definite symptoms of distress, and there is no doubt that their yield was adversely affected. It should be noted that this damage occurred only under the peculiar conditions of the Sowing Date—Variety Trial (*see* Section B). The size of infestation on the Experiment was due, at least in part, to the presence of blocks of April-sown cotton; during the previous two seasons Jassid population at Serere remained at an exceedingly low level till October. This year, however, slight symptoms of Jassid attack were noticeable on April-sown plots of S.P.90 at the end of June, while in August the nymph population per 50 leaves on these blocks was already greater than the peak population recorded in November, 1936; in September the later-sown blocks were invaded by large numbers of Jassids from the surrounding early-sown blocks, thus developing a considerable infestation much earlier than would otherwise have been the case; in addition, there was a marked concentration on to the plots of the more susceptible varieties. Three isolated experiments planted with S.P.90 remained very free from Jassids till late in the season, when nearly all their crop had matured.

11. Jassid infestation in other parts of the Northern and Eastern Provinces visited by the writer was, as usual, nearly everywhere entirely negligible. Late in the season a few cases of slight symptoms of Jassid infestation on native-grown plots were noticed, but no evidence of real damage was seen.

12. Nymph population counts were done on all the District Variety Trials in these areas in the course of various safaris; in most cases the populations recorded were very small, the only ones of any consequence being a late infestation on the Nyero Variety Trial, and on the Katakwe Variety Trial in September (this trial was planted on April 9th). In some cases moderate infestations were reliably reported after the trials had been visited by the writer. With the possible exception of the Katakwe trial, all these were too late to have any effect on the crop.

13. *Nymph Population Counts.*—As last year, the basis of these counts is the number of nymphs on five leaves on each plant examined; in all cases samples of twenty plants per plot were taken, the results being expressed as the average number of nymphs on fifty leaves for

comparison with previous records. The figures for a count on the Miniature Variety Trial at Serere are given in the Botanist's Report. Selections from other counts done are tabulated below:—

(i) SERERE SOWING DATE-SPACING-VARIETY TRIAL.

Fourth Sowing Date (July): Varieties  $\times$  Time of Counting  
(all spacings).

| Time of Counting. | S.G.29 | S.P.20 | S.P.84 | S.P.90 | S.P.92 | S.P.102 | Least Significant Difference. |
|-------------------|--------|--------|--------|--------|--------|---------|-------------------------------|
| October ..        | 10.62  | 13.25  | 23.58  | 45.58  | 28.50  | 8.29    | 11.83                         |
| November ..       | 21.87  | 30.95  | 40.62  | 70.50  | 62.79  | 11.62   | 12.79                         |
| December ..       | 27.37  | 29.87  | 30.33  | 27.29  | 42.62  | 20.50   | 5.70                          |

Further counts done on other sowing dates gave similar results, and there is no doubt that the order shown in the October and November counts above represents the true order of susceptibility of the varieties concerned, and that if sufficient counts had been done it would have been possible to demonstrate significant differences between the Jassid population on each pair of varieties. In December growth had almost ceased, and the low figure for S.P.90 in this count was due to the effect of earlier infestation in checking growth, making it unsuitable for a large population. There was no indication that spacing had any influence on the density of population.

(ii) DISTRICT VARIETY TRIALS.

1. Teso and Bukedea.

(a) Counts done 3-3½ months after sowing.

| Centre.              | S.G.29 | S.P.20 | S.P.84 | S.P.90 | Least Significant Difference. |
|----------------------|--------|--------|--------|--------|-------------------------------|
| Katakwe .. ..        | 4.0    | 3.8    | 6.6    | 14.1   | 4.8                           |
| Serere .. ..         | 5.5    | 4.1    | 6.3    | 14.6   | 4.5                           |
| Nyero .. ..          | 3.9    | 6.4    | 7.4    | 11.0   | 3.6                           |
| Bukedea .. ..        | 2.6    | 3.0    | 3.1    | 5.8    | ..                            |
| Combined analysis .. | 4.0    | 4.3    | 5.8    | 11.4   | 1.8                           |

(b) Late Counts.

| Centre.              | Month.    | S.G.29 | S.P.20 | S.P.84 | S.P.90 | Least Significant Difference. |
|----------------------|-----------|--------|--------|--------|--------|-------------------------------|
| Katakwe .. ..        | September | 14.8   | 20.3   | 22.5   | 43.6   | 11.9                          |
| Serere .. ..         | November  | 15.4   | 13.5   | 17.4   | 29.5   | 6.5                           |
| Nyero .. ..          | December  | 37.4   | 41.1   | 50.8   | 55.5   | ..                            |
| Bukedea .. ..        | December  | 2.1    | 3.5    | 4.0    | 4.4    | ..                            |
| Combined analysis .. | ..        | 17.4   | 19.6   | 23.7   | 33.3   | 6.6                           |

In (b) counts at the first three trials all represent peak population; the differences at Nyero are not significant owing to the lateness of the count, the size of population on the more heavily attacked plots being limited by the effect of earlier infestation.



## 2. N.17. Centres: Lango (November) and Busoga (December).

| Centre.              | N.17 | S.P.20 | S.P.84 | S.P.90 | Least Significant Difference. |
|----------------------|------|--------|--------|--------|-------------------------------|
| Ngetta .. ..         | 8.3  | 6.1    | 7.1    | 20.0   | 3.3                           |
| Aduku .. ..          | 3.1  | 1.5    | 1.4    | 2.3    | ..                            |
| Kaberamaido .. ..    | 4.6  | 3.6    | 3.8    | 6.1    | ..                            |
| Iganga .. ..         | 6.9  | 2.5    | 5.6    | 8.8    | 3.6                           |
| Bulopa .. ..         | 11.5 | 4.1    | 4.6    | 11.8   | 3.0                           |
| Bugaya .. ..         | 7.9  | 3.6    | 7.0    | 11.4   | 4.0                           |
| Vukula .. ..         | 9.8  | 5.1    | 11.5   | 15.1   | ..                            |
| Combined analysis .. | 7.4  | 3.8    | 6.0    | 10.8   | 1.3                           |

## 3. Busoga: Bukalasa Series (December).

| Centre.              | N.17 | M.1 | B.P.52 | S.P.102 | Least Significant Difference. |
|----------------------|------|-----|--------|---------|-------------------------------|
| Iganga .. ..         | 12.6 | 7.3 | 5.9    | 2.6     | 5.0                           |
| Bulopa .. ..         | 4.0  | 7.8 | 4.4    | 3.5     | ..                            |
| Bugaya .. ..         | 5.1  | 4.4 | 2.5    | 0.8     | 2.8                           |
| Vukula .. ..         | 4.6  | 3.1 | 2.6    | 1.1     | 1.9                           |
| Combined analysis .. | 6.6  | 5.6 | 3.8    | 2.0     | 1.3                           |

In the last table the interaction Variety  $\times$  Centre is significant (least significant difference = 2.8) because the population on N.17 at Bulopa is, by this test, significantly lower than M.1, while at other centres it is considerably higher. The position of N.17 at Bulopa is obviously irregular, probably due to the patchiness of this trial; if this trial is omitted from the combined analysis, the result shows N.17 to have a significantly higher Jassid population than M.1.

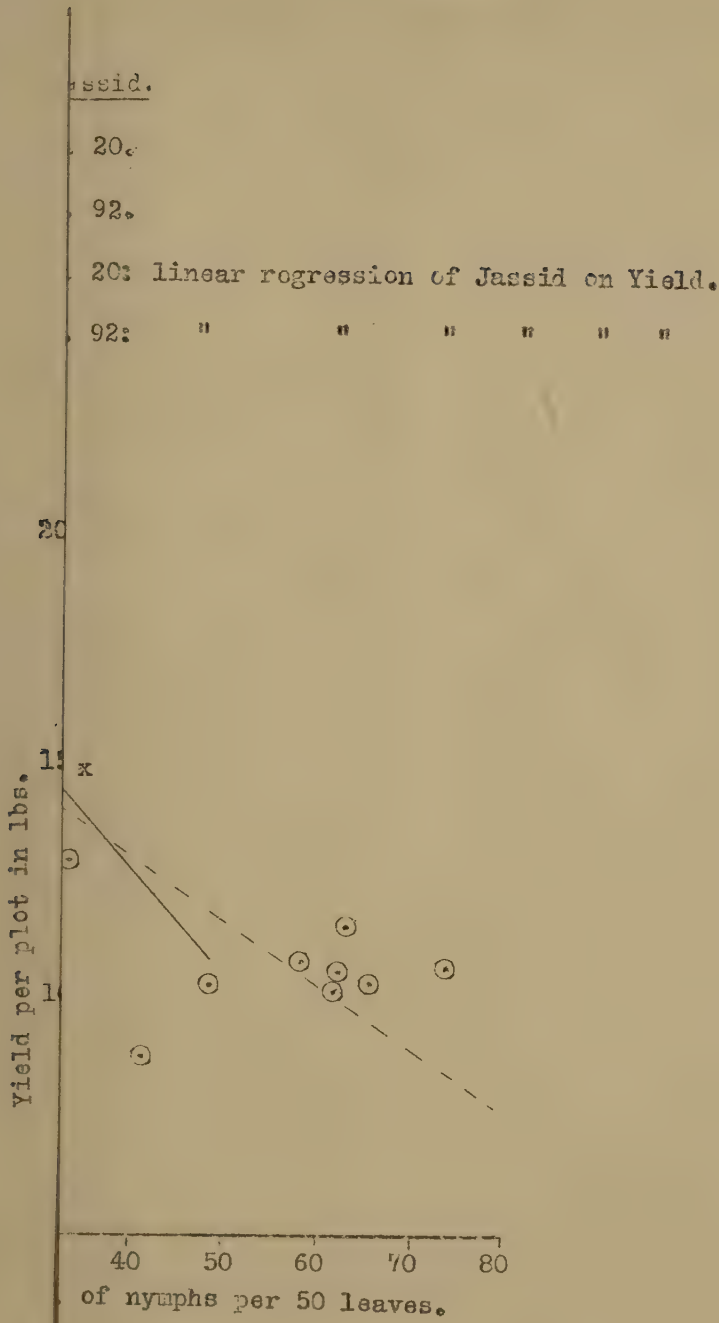
*Jassid Test Cage.*—Each compartment was planted on July 1st, with two lines (6 plants per line) of each of the varieties in the Sowing-date, Spacing, and Variety Trial, but substituting the known Jassid-susceptible S.P.88 for S.G.29. About 500 Jassid nymphs were introduced into one compartment at the end of August. The nymphs of the F.1 and subsequent generations showed the usual tendency to congregate on to the more susceptible varieties. The population reached a maximum on October 23rd, when the average number of nymphs per plant (= 5 leaves) on each variety were as follows:—

|        |        |        |        |        |         |
|--------|--------|--------|--------|--------|---------|
| S.P.88 | S.P.20 | S.P.84 | S.P.90 | S.P.92 | S.P.102 |
| 13.8   | 7.9    | 8.5    | 14.2   | 13.3   | 4.5     |

This shows the same order of susceptibility as that shown on the variety trials. After this the population declined as growth slowed down. The two most interesting results of the experiment were:—

(i) The indication that S.P.92 is nearly as susceptible to Jassid as S.P.88, while S.P.90 is probably more so.

(ii) The first effect of the Jassid nymphs was apparent within three days of their introduction into the cage; this was a slight bronzing in angular areas around the edges of leaves on which Jassid nymphs were feeding. No such symptoms were discernible in the other







compartment which was free of Jassids. This effect can be produced by the feeding of a single nymph.

### Notes on Varieties.

*N.17.*—The seed was, deliberately, a very impure sample from Jinja. M.1 was a comparatively pure sample of seed from Namaganda, further purified by removing black and green seeds. The foregoing results indicate that the "Jassid status" of commercial N.17 could be improved by a redistribution of pure, or nearly pure, seed.

*S.P.84.*—Moderately susceptible. It is the parent of S.P.90, and contains a sprinkling of glabrous plants of the type, so its resistance could be improved by the elimination of more glabrous forms. However, as it stands it appears to be slightly less susceptible than N. 17 (*q.v.*).

*S.P.90.*—Very susceptible to Jassid; there is little doubt that under conditions where it was subject to severe infestation it would be a complete failure, and even in Uganda it would be liable in some years to suffer damage locally, at least in certain districts.

*S.P.102.*—Consistently the most resistant of all Serere varieties. It was interesting to find that members of the Cotton Conference considered it the only one of our varieties which comes up to the standard of resistance considered necessary in Southern African territories, where Jassid is a serious problem.

### B. Correlation between Yield and Jassid.

The correlation between yield of total seed cotton and Jassid infestation (as indicated by the combined results of the October and November counts) was worked out separately for each variety in the July sowing-date<sup>1</sup>. This is illustrated by the accompanying graphs.

|               | 1                                 | 2                             | 3    | 4                               | 5                 | 6                     |
|---------------|-----------------------------------|-------------------------------|------|---------------------------------|-------------------|-----------------------|
|               | Jassid infestation per 50 leaves. | $r$<br>Yield $\times$ Jassid. | P.   | Actual Yield: average per plot. | 'Potential' Yield | Col. 4 as % of Col. 5 |
|               |                                   |                               |      | lbs.                            |                   |                       |
| S.P.102 .. .. | 10                                | —·481                         | >·1  | 16·43                           | (19·89)           | (83)                  |
| S.G.29 .. ..  | 16                                | —·727                         | <·01 | 11·37                           | 16·13             | 70                    |
| S.P.20 .. ..  | 22                                | —·667                         | <·02 | 17·05                           | 21·97             | 78                    |
| S.P.84 .. ..  | 32                                | —·852                         | <·01 | 16·35                           | 21·62             | 76                    |
| S.P.92 .. ..  | 46                                | —·856                         | <·01 | 12·60                           | 18·73             | 67                    |
| S.P.90 .. ..  | 58                                | —·944                         | <·01 | 12·58                           | 20·72             | 61                    |

As shown by Column 3, the correlation between yield and Jassid population was significant for all varieties except S.P.102, and in most cases very highly significant. Careful examination failed to reveal any other factors which might have contributed to this result<sup>2</sup>, and there

<sup>1</sup> The correlations were worked out by Mr. Hosking, whose assistance in this and other statistical work the writer takes this opportunity of acknowledging.

<sup>2</sup> The correlation between Yield (Y), Jassid population (J), and weight of vegetative matter (V) was worked out for S.P.90:—

$$Y \times V: r = +0.633; P < .05. \quad J \times V: r = -0.591; P < .05.$$

$$Y \times J.V.: r = -0.913; P < .01.$$

This merely shows that Jassid infestation had a tendency to depress V as well as Y, and does not affect the main conclusion.

seems no doubt that the correlation is a true one, *i.e.*, that there was a direct relationship between yield and Jassid infestation. Column 5 was obtained by producing the linear regression of Jassid on yield to the zero axis for Jassids. It is not necessarily a true measure of the "potential" yield in the complete absence of Jassids. If we accept the reasonable assumption that infestations of up to 12 nymphs per 50 leaves have a negligible effect on yield and take this as the basic axis, the effect of Jassid on yield is seen to be considerably reduced. However, Column 6 appears to be a good index of the relative effect on the different varieties. It seems probable that the effect of Jassid infestation on S.P.90 was to depress the yield by about 30% of the "potential" yield: in the case of the most heavily infested plot, which had an average infestation of 114 nymphs per 50 leaves, the actual yield was under 30% of the "potential" yield.

Scrutiny of the detailed figures indicates that, under the conditions of this trial, average infestations on individual plots of over 12 nymphs per 50 leaves were likely to have a depressing effect on yield. This is a surprisingly low figure.

It is necessary to emphasise that though this infestation was not particularly high, it was exceptional for Uganda, and the population on the more susceptible varieties was in fact the biggest which has yet been recorded on cotton in this country. Further, this infestation had every opportunity to exercise its maximum effect; the bugs came on to this cotton when it was still young, soon reached their maximum density, and remained at about this level till nearly all the crop had been set. As already pointed out, the conditions which gave rise to this abnormal infestation were peculiar: it is true that early and late sown plots of cotton occur side by side in native practice, but this is not the same as the systematic lay-out of a sowing date trial, to which must be added the effect of the inclusion of highly susceptible varieties, acting as foci for the dispersal of large numbers of Jassids to the surrounding plots of less susceptible varieties. The greatest effect in this respect was exercised by early-sown plots of susceptible varieties abutting on late-sown blocks. This resulted in the bombardment of the latter with large numbers of Jassids from the former at a time when late-sown plots would, under normal circumstances, still be almost free from Jassids. Examination of the plan of the experiment showed that the great variations in intensity of Jassid infestation, which made it possible to trace the correlation, were entirely due to the position of the individual plots in relation to the earlier sown blocks.

Other points of interest are:—

(i) S.G.29 appears to suffer more from a given population density per 50 leaves than other varieties. There are a number of possible explanations of this, one of the more probable being that this variety suffers badly from Angular Leaf Spot and Black Arm, and so is less able to suffer damage to its surviving leaf surface without ill effects.

(ii) In other varieties the greater the susceptibility to Jassid as indicated by Column 1 the closer the correlation between yield and infestation, and the greater the reduction in yield due to Jassid.

(iii) The correlation between yield and Jassid is not significant in the case of S.P.102 presumably because the Jassid population was in nearly all cases too low to affect yields to any extent. Even so, the plot with the lowest yield had also the highest Jassid population; it was surrounded on two sides by plots of susceptible varieties of earlier sowing dates.

Adequate series of Jassid population records were not available for the other sowing dates; the maximum populations recorded on these were very much smaller.

### *C. Conclusions.*

(i) The outstanding result of counts done during the past season was the remarkable series of correlations between yield and Jassid infestation on the July sowing of the main trial at Serere. This points to the conclusion that yield is affected by a much smaller Jassid population than had hitherto been supposed.

(ii) This infestation was still very much more intense than any which is likely to occur in ordinary cultivation except in very abnormal seasons, and the conditions under which it occurred were peculiar.

(iii) An incidental consequence of this result is to show that the present method of recording Jassid infestation is accurate and reliable.

(iv) The very extensive series of Jassid nymph counts done during the past three seasons have done much to clarify the position as regards Jassid in Uganda. It is evident that only a very modest degree of Jassid resistance is required in our cottons. However, as in pursuit of quality the plant breeder is in many cases forced to concede as much as he safely can in the matter of resistance, and in view of the occurrence of occasional seasons when Jassids are unusually abundant, it is necessary to keep a careful watch on the degree of resistance in new varieties. As Jassid resistance is closely correlated with the hairiness of the leaves, with a little experience the plant breeder can judge the resistance of any variety by feel and eye. Nevertheless, population counts appear to be of considerable assistance in certain cases.

(v) Enough has been said to show that Jassids are now primarily a plant-breeding problem. It is believed that sufficient entomological work has been done on the question to enable the plant breeder to plan whatever series of population counts he considers desirable. At the same time, occasional entomological assistance in organising these counts will no doubt be of value.

A. M. GWYNN,  
*Entomologist.*

## REPORT OF THE SENIOR PLANT PATHOLOGIST.

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I was on duty throughout the year under review and with the exception of a tour with the Chemist through the coffee areas of the Western Province in July and August, I remained at the laboratories at Kampala.

A number of matters arose in connection with the building of the new laboratories at Kawanda and the gas and water supplies to these. Several consultations were held with the Architect and other staff of the Public Works Department in this connection.

The manuscript of the departmental publication "Agriculture and Agricultural Research in Uganda" was completed at the end of May and handed over to the Director of Agriculture for final revision prior to publication; the preparation and editing of contributions to this book occupied my whole time during the early part of the year.

The safari through the coffee areas of the Western Province during July and August was undertaken to attempt to correlate the incidence of *Antestia* ("Coffee Bug") with climatic and soil factors; during the tour a mass of observational data was collected and the statistical analysis of this took two months to complete. A separate report on the results has already been submitted and a full account was prepared for publication in England: the latter was returned with a number of criticisms from the referee to whom it was submitted and these have been met by re-examination of the data where necessary. A revised account will be re-submitted for publication at a later date.

In November a Cotton Conference of delegates from various territories in Africa was held at Kampala and the contact with workers outside Uganda was much appreciated and extremely helpful.

During the absence on home leave of Mr. Thomas, the work of the Botanical Herbarium devolved upon me, and much time was spent in revision and indexing to bring the whole herbarium up to date. Mr. W. J. Eggeling gave us much assistance in this work and is incorporating our records in his account of the Trees and Shrubs of Uganda.

### Wilt Diseases.

During the year a collection was accumulated of organism associated with Wilt diseases of cotton, simsim, cassava, sunn hemp, *Derris*, *Crotalaria striata*, *Capsicum annum*. *Tephrosia vogelii*, etc., mostly occurring on the Kampala Plantation. The organisms isolated from these diseases were studied in culture and the obvious saprophytes sorted out and discarded. The remainder include a large series of species of *Fusarium* and *Verticillium dahliae*. Preliminary cross-inoculation work has been commenced with these cultures, to determine to what extent



each is limited to its particular host plant. In the field *Verticillium dahliae* has been isolated from wilted plants of cotton, cassava, simsim, *Tephrosia*, and *Abroma*, while in series of laboratory inoculation experiments it has been found pathogenic to young seedlings of these plants, as well as to *Capsicum* and *Crotalaria striata*. Infection by *Verticillium dahliae* can occur in the absence of any damage to the root systems of susceptible plants, as has been proved by sowing seed of these in inoculated soil; on the other hand a much larger proportion of successful inoculations occurs when the plants are allowed to grow for a few weeks in the pots used for inoculation before the cultures are added to the soil, when in the process of mixing the culture with the upper layers of soil a number of the finer roots are damaged. This supports the observations made in previous years at Bukalasa Experiment Station, where it was found that infection could often be traced back to a damaged root.

The *Fusarium* flora of wilted plants in Uganda is very varied and includes forms belonging to most of Wollenweber's sections of this genus. For the present attention is being confined primarily to the study of strains of section *Elegans*, in view of experience in Uganda and elsewhere that many of the forms of this section are pathogenic. Preliminary cross-inoculation studies have indicated that the Wilt disease of *Crotalaria striata* due to a *Fusarium* of this group is transferable to *Crotalaria juncea* and that the *Fusarium* isolated from the latter is also pathogenic to *C. striata*. These cross-inoculation experiments are complicated by the apparent complete immunity of individual plants to the organisms used, this applies both to the original host plant from which the *Fusarium* was isolated and to the alternative host used in the trials. In consequence large series of plants must be used in each experiment before it is possible to be certain of the reaction of each species of host to the fungus used. Successful cross-inoculations with the two strains of *Fusarium* mentioned have been obtained both after wounding the test plants and by inoculation of the soil before sowing the seed; the former method gives a much higher proportion of successes.

In one series of trials a *Fusarium* isolated from wilted *Capsicum annum* gave positive results on inoculation into *Crotalaria striata*, but attempts to reproduce this result have so far been unsuccessful.

At this stage of the work it is only possible to state that some evidence has been obtained that the *Fusaria* associated with Wilt diseases of some plants in Uganda are not restricted in pathogenicity to a single species of host.

### Black Arm Disease.

In response to enquiries received for pathogenic cultures of *B. malvacearum*, isolations were made from lesions on cotton plants growing at Kampala Plantation. In every instance these isolations were not typical in their cultural and fermentation reactions, though they produced lesions on the leaves of young plants of cotton in inoculation experiments. These bacteria were re-isolated from the lesions thus produced, and

the process of inoculation and re-isolation repeated twice more. In every case what appeared to be the original bacterium was obtained, and comparison in culture with the latter confirms this. In previous seasons no difficulty was found in obtaining typical strains of *B. malvacearum*, but during the 1937-38 season it proved impossible to obtain such from the cotton at Kampala. The proved existence of variants of *B. malvacearum* in Uganda has now raised the question as to what extent these varieties differ in pathogenicity to the varieties of cotton bred here for resistance to Black Arm Disease. It is hoped to carry out a test of the susceptibility of certain of the more promising varieties of Uganda cotton to a number of different strains of *B. malvacearum* during the coming season, to determine whether the present method of relying on natural infection in the field is sufficiently reliable as a basis of selection for resistance. Hitherto we have relied upon the results of estimates of infection obtained at Serere and Bukalasa under normal field conditions to distinguish between resistant and susceptible varieties of cotton, and to some extent upon such supplementary observations as have been possible on small variety trials conducted in different parts of the country.

The culture isolated this past season at Kampala differed from normal in the production of very large amounts of yellow slime on dextrose and saccharose media, and in forming no acid on dextrose media. On nutrient agar it is much brighter yellow in colour than normal strains.

### Bacterial Leaf Spot of Castor Oil.

During the wet weather of September and October a bacterial leaf spot of *Ricinus* became very common on a number of selections of the crop grown at Kampala. The causal bacterium was isolated and sent to Cambridge; I am indebted to Mr. W. J. Dowson for its determination as *Bacterium ricini*. Although some of the selections proved less susceptible than others on which the disease caused much leaf fall, none of those grown at Kampala proved immune.

### Plant Diseases in Uganda in 1937.

#### *Cotton Wilt Disease.*

New foci of infection continued to be discovered during the 1937-38 season and the disease has now been recorded from almost every cotton growing area of importance. Infection is in most cases limited to individual plants or small groups of plants and only in areas where the disease is comparatively of long standing is infection more serious. On the whole the disease was of no economic importance during the past season, and even in areas where it had caused damage in the past infection was of comparatively limited extent. It is now becoming evident that to some degree the incidence of the disease in plots known to be infected is governed by external conditions, possibly of climate. For instance, in the 1931-32 season infection in Mengo and Masaka Districts was higher than in more recent years, though the same cotton variety has been planted every year. At Bukalasa Experiment Station, on the other

hand, infection by Wilt disease shows a general increase year by year and each year a few plots previously free from the disease become infected.

In connection with cotton breeding work at Bukalasa mass cultures of *Verticillium dahliae* were prepared for use in soil inoculation of test plots on that station, to assist in the selection of strains of cotton resistant to Wilt. In spite of this inoculation, however, the incidence of the disease was very low, and it appears that soil inoculation under field conditions is not sufficiently reliable as a test for resistance in cotton. During the coming season it has been decided to carry out a special test for Wilt resistance in one or two of the most promising new varieties of cotton likely to prove of commercial value in Buganda Province, by growing the plants in pots in which the soil has been thoroughly inoculated to a depth of about 18 inches with cultures of *Verticillium*. Apparently the disappointing results obtained under field conditions are due to the difficulty of ensuring an even distribution of the inoculum through the upper soil layers, with the result that the root system of the test plants does not come into contact with the inoculum. In pot cultures, on the other hand, it is possible to inoculate each layer of soil at the time of filling the pots, and in this way it is hoped to obtain a rigid test of resistance.

#### *Tobacco Mosaic Disease.*

This has proved again a limiting factor to tobacco production in Ankole District, where the disease assumes a very serious form, probably due to climatic causes. Affected plants show a large number of brown indistinctly zonate spots on the leaves, which are rendered completely unsaleable. The disease spreads rapidly in the fields and in many plots a high proportion of the plants become infected.

#### *Sugar Cane Diseases.*

Mosaic disease still remains unimportant in Uganda, owing to the cultivation of very resistant or immune varieties. Red Stripe disease is common on P.O.J.2727, which is less resistant than P.O.J.2725 and P.O.J.2878. The first of these varieties is being discarded for other reasons and it is fortunate that the latter two suffer comparatively little damage when infected with this disease. At the same time it is important to keep infection at a low level, and attempts to reduce infection by selection of planting material from the most healthy fields appear to be giving satisfactory results.

Several of the Coimbatore varieties are susceptible to the leaf spot disease caused by *Cercospora sacchari*, which forms very numerous reddish brown lenticular spots on the leaves; in dry weather especially plots of these varieties have a brown appearance, as compared with neighbouring plots of P.O.J. canes. As far as can be ascertained little or no loss of crop is caused by the attack and for the present the disease is being ignored. The Uba variety is also very susceptible to infection by this fungus.

#### *Tea Diseases.*

Several reports of attack by *Armillaria* were received during the year, but in each case attack was limited to individual bushes and this



disease has not become of economic importance in Uganda, possibly due to the fact that our tea estates here are situated on old elephant grass land, in which roots of trees and shrubs are relatively infrequent.

Some trouble was reported on one estate with the death of young plants a few months after transplanting. The fungi found on the dead and dying plants were saprophytic or only weakly parasitic and the cause of death was attributed to water-logging of the soil around the plants.

#### *Disease of Derris elliptica.*

Considerable trouble has been experienced on the Kampala Plantation with the propagation of stocks of this insecticidal plant. The cuttings make fair growth at first but later the shoots die back almost to the base. A *Diplodia* resembling the conidial stage of *Physalospora fusca* is common on the dead shoots, and a *Fusarium* of the *Elegans* group has been isolated from discoloured vascular bundles in the living part of the affected shoots a few inches behind the edge of the dead tissues. The discoloured vascular tissues have not been found to extend throughout the plant into the main stem and roots, as is the case with normal Wilt diseases. Hitherto the disease has not been reproduced by inoculation, but a disease of *Derris dalbergioides* due to *Diplodia* sp. is recorded by Steinmann in Java (*de Bergcultures*, v, p. 255, 1931) causing heavy damage.

#### *Cotton Diseases.*

*Kuehneola gossypii* (Cotton Rust) was found common at Kampala Plantation in December and January—this is only the second record of this in Uganda. Little damage appeared to result on the varieties of cotton affected.

The Uganda selections from U.4.4.2 are more susceptible to infection by Areolate Mildew (*Cercospora gossypii*) than either Nyasaland Upland or "Buganda Local" selections. In spite of comparatively heavy infection, however, little leaf shedding results and the varieties of the first group are heavy yielders under the conditions of the Eastern Province of Uganda. The only direct damage caused by this disease is due to infections on the bolls; these are often invaded by bacteria, which produce lesions closely simulating those of *B. malvacearum* in appearance, and extend through the boll walls to cause a rot of the contents. The bacteria isolated from these lesions have not proved capable of invading uninjured bolls.

#### *Scab Diseases.*

A collection of species of *Elsinoe* and *Sphaceloma* causing scab diseases of native and cultivated plants was commenced. Attempts to isolate these in pure culture were unsuccessful, due partly to the extremely slow growth of these fungi and partly to the presence of a number of budding fungi covering the surface of the lesions on the host plants. As far as is known these fungi are each restricted to a very small range of hosts, and during the year several new species were collected.



A scab disease is very common on *Hydnocarpus Wightiana* at Kampala and Entebbe, on branches and fruits. It causes the death of many of the lower branches, which are covered with large corky outgrowths. These contain a very variable fungus flora, including species of *Septoria*, *Oospora* and *Fusarium*, but hitherto none of these has been found to be constantly associated with the disease. Although the appearance of young lesions on the fruits suggests the presence of a *Sphaceloma* or *Elsinoe*, none has yet been found on them.

### Sugar.

A number of experiments are in progress on one estate in Uganda, but the results are not yet to hand. Attention has been devoted to endeavours to obtain a variety of cane capable of replacing P.O.J.2725 should occasion arise; a number of varieties were received at the Amani Quarantine Station from India, South Africa and Barbados. The varieties released from the Amani Station were planted at Lugazi and Kakira during the year; although some show promise, it is still too early to determine their future value to the Uganda Sugar industry. At present it appears that hybrids of P.O.J.2725 are most likely to prove suited to Uganda conditions.

A number of visits were made to Lugazi Estate for consultation on sugar matters.

### Uganda Fungi.

The collection of these has continued throughout the year whenever time permitted, and a large number of specimens were distributed to the Herbarium at Kew, to the Imperial Mycological Institute, to Amani Herbarium and to Dr. Sydow in Berlin. Through the kindness of the staff at Amani I was permitted to examine the whole of the fungus material in the Herbarium of that Institution, and I have also to thank the Director of Amani for the loan of a copy of Saccardo's *Sylloge Fungorum*, which has been an invaluable help in the determination of fungi collected here. Mr. P. Chandler and other collectors in Uganda have given me much assistance in collection of material.

Two papers on the Meliolineæ of Uganda were sent to the *Journal of the Linnean Society of London*; the first has already appeared and the second is in the press. Other papers on Uganda Fungi are in course of preparation; an Annotated Host List of Uganda Fungi was published in the *East African Agricultural Journal*, being completed, as far as could be ascertained, up to January, 1937.

In conclusion I have to thank the staff of the Royal Botanic Gardens, Kew, and that of the Imperial Mycological Institute, as well as Dr. H. Sydow of Berlin, for many determinations of Uganda Fungi and for much assistance in other matters.

C. G. HANSFORD,  
*Senior Plant Pathologist,*

## REPORT OF THE CHEMICAL SECTION.

### Introductory.

During the year attention has continued to be focussed upon soil problems connected with erosion and with the regeneration of worn-out land, the Senior Chemist having devoted his time entirely to the field study of these problems. Other work of importance has included an extensive study of coffee soils, a reconnaissance of the tea areas, and a continuation of the investigations on cotton seed and cotton seed oil with regard to their local utilisation.

The following is a summary of the laboratory work carried out:—

|                                         |    |    |    |     |
|-----------------------------------------|----|----|----|-----|
| Soil Reaction                           | .. | .. | .. | 400 |
| Comber Thiocyanate Colour               | .. | .. | .. | 180 |
| Moisture at Sticky Point                | .. | .. | .. | 20  |
| Organic Carbon                          | .. | .. | .. | 195 |
| Organic Nitrogen                        | .. | .. | .. | 232 |
| Available Nutrients:—                   |    |    |    |     |
| Phosphate                               | .. | .. | .. | 165 |
| Potash                                  | .. | .. | .. | 77  |
| Calcium                                 | .. | .. | .. | 165 |
| Foodstuffs—Complete analysis            | .. | .. | .. | 13  |
| do Nitrogen and moisture only           | .. | .. | .. | 18  |
| Citral determination on lemon grass oil | .. | .. | .. | 6   |
| Manures                                 | .. | .. | .. | 12  |

### Erosion and Regeneration (Serere Experiments).

#### 1. Erosion Experiment.

The erosion experiment layout has already been fully described<sup>1</sup>. This year the experiment was again put down to cotton after having carried a crop of small millet (*Eleusine coracana*). Climatic conditions were on the whole favourable for both growth and harvesting. The yields of cotton are given in Table I, the treatments being (A) Lemon Grass contour hedges, (B) Contour bunds planted with *Harrisonia*, (C) Bush strips, (D) Contour strips of trash, (E) No treatment.

The 1936–37 block totals reading from the top to the bottom of the slope were 376, 390, 685, 641 and 683. The right-hand column of Table I shows that the yields of Blocks III, IV and V are higher than I and II. Thus again this year there is a definite increase in fertility

1. *East African Agricultural Journal*, Vol. 2. No. 5, W. S. Martin and C. E. J. Biggs



as one goes down the slope. Last year it was thought that this might be due to the turning under of *Aframomum* which is bulky and of low nitrogen status and was predominant in the top two blocks when the land was first opened. Such an effect cannot be expected to persist into the second cotton crop, and it is therefore clear that the fertility gradient is a natural one probably due to past erosion.

The results also show a significant difference in yield in favour of ploughing as against hand-cultivation. This is of great interest and will be referred to again later in this report in connection with observations with the Culpin compactometer.

## 2. Fertility Experiment.

The first cycle of the fertility experiment also carried its second crop of cotton after an intervening crop of small millet. After the millet was harvested the manurial treatments of  $2\frac{1}{2}$  and 5 tons per acre of farm-yard manure were applied according to plan and the yields are given in Table II.

TABLE II.—YIELDS OF COTTON IN LBS. PER ACRE AFTER DRESSINGS OF FARMYARD MANURE.

| Treatment. | No manure. | $2\frac{1}{2}$ tons F.Y.M. | 5 tons F.Y.M. |
|------------|------------|----------------------------|---------------|
| Block 1 .. | 655.0      | 674.0                      | 608.0         |
| Block 2 .. | 566.0      | 600.0                      | 580.0         |
| Mean .. .. | 611.0      | 637.0                      | 594.0         |

Mean yield of seed cotton per acre = 613.8. The differences are not significant.

Cycle II of this experiment carried its first crop of the same cotton (S.P.20). In its first year each cycle is merely a uniformity trial. The mean yield per acre of these blocks was 517.7 lbs. of seed cotton. Cycle III of this experiment has been prepared for sowing of cotton in the 1938-39 season.

## Correlation of Soil Analysis with Yield of Cotton and with *Lygus* Attack.

In the first season soil samples were taken from the top and bottom plots of the Erosion Experiment and from all the plots of Cycle I of the Fertility Experiment. Determinations of organic carbon, nitrogen, potassium, phosphate, and calcium were made on all these samples and statistical analysis showed no correlation between any of these factors and the yield of cotton.

Tables III and IV give data selected from the main variety, sowing date and spacing trial, namely from pairs of plots of the same variety, spacing, and sowing date, and it will be seen again that there is no statistical correlation between soil factors as determined and either yield of cotton or *Lygus* infestation.



TABLE III. (means of 14 plots).

|                                       | High-yielding<br>plots. | Low-yielding<br>plots. |
|---------------------------------------|-------------------------|------------------------|
| Cotton (lbs. per plot) .. ..          | 23.9                    | 14.7                   |
| % Moisture at Sticky Point ..         | 18.4                    | 18.3                   |
| Nitrogen % .. ..                      | 0.087                   | 0.085                  |
| CaO % .. ..                           | 0.164                   | 0.163                  |
| P <sub>2</sub> O <sub>5</sub> % .. .. | 0.0042                  | 0.0045                 |
| K <sub>2</sub> O % .. ..              | 0.0188                  | 0.0187                 |
| Organic Carbon % .. ..                | 1.14                    | 1.12                   |
| C/N ratio .. ..                       | 13.1                    | 13.2                   |

TABLE IV.

|                                       | Low <i>Lygus</i><br>counts. | High <i>Lygus</i><br>counts. |
|---------------------------------------|-----------------------------|------------------------------|
| Count .. ..                           | 205                         | 430                          |
| % Moisture at Sticky Point ..         | 17.5                        | 17.8                         |
| Nitrogen % .. ..                      | 0.080                       | 0.085                        |
| CaO % .. ..                           | 0.145                       | 0.155                        |
| P <sub>2</sub> O <sub>5</sub> % .. .. | 0.0044                      | 0.0039                       |
| K <sub>2</sub> O % .. ..              | 0.0171                      | 0.0175                       |
| Organic Carbon % .. ..                | 1.04                        | 1.06                         |
| C/N ratio .. ..                       | 12.9                        | 12.6                         |

These results appear to indicate that in this case the limiting factors controlling the yield of cotton is not the nutrient content of the soil. This must of course not be taken to mean that the nutrient content of the soil has no effect on fertility as expressed by yield of cotton as it has been amply demonstrated that such is not the case.

It indicates merely the desirability of considering the soil as a physical entity in addition to its purely food supplying characters. This may appear almost axiomatic but it is nevertheless a fact that soil texture in all its aspects has been too long neglected. The reason for this has mainly been the lack of standardised methods of assessment of structure. One line of approach lies in a measure of the compactness of a soil and this year the Culpin compactometer<sup>1</sup> has been used for this purpose.

A large number of measurements have been made with this instrument and the results so far have been suggestive. A detailed account of the work would possibly be premature, but among the interesting facts brought out has been the fact that ploughed plots gave significantly less resistance to the probe than those cultivated by hand.

1. Culpin, C., *J.A.S.* (1936) XXVI, pp. 22-35.

TABLE V.—RESISTANCE TO COMPACTOMETER PROBE, LBS./SQ. INCH (Mean measurements, to depth of 6 inches).

| Ploughed.      |       |       |       |       | Hand Cultivated. |       |       |       |       |       |         |
|----------------|-------|-------|-------|-------|------------------|-------|-------|-------|-------|-------|---------|
| A              | B     | C     | D     | E     | Total.           | A     | B     | C     | D     | E     | Total.  |
| I .. 34.9      | 32.5  | 27.4  | 36.1  | 29.0  | 159.0            | 73.9  | 55.9  | 63.6  | 66.4  | 73.1  | 332.9   |
| II .. 43.9     | 38.7  | 58.3  | 36.8  | 43.1  | 220.8            | 75.0  | 76.5  | 67.6  | 67.2  | 87.0  | 373.3   |
| III .. 37.6    | 58.4  | 28.3  | 46.4  | 52.4  | 223.4            | 84.4  | 58.9  | 76.6  | 60.5  | 63.1  | 343.5   |
| IV .. 48.6     | 39.2  | 38.9  | 35.8  | 34.7  | 197.2            | 67.6  | 59.2  | 83.3  | 79.8  | 62.5  | 352.4   |
| V .. 56.6      | 42.6  | 63.7  | 36.0  | 54.5  | 253.4            | 62.5  | 94.8  | 85.1  | 91.7  | 72.2  | 406.3   |
| TOTAL .. 221.6 | 211.4 | 216.6 | 191.1 | 213.7 | 1,054.4          | 363.4 | 345.3 | 376.2 | 365.6 | 357.9 | 1,808.4 |

This difference is reflected in the yields of cotton, as will be seen by comparisons of Tables I and V which refer to the same experimental area.

### The Kampala Regeneration Experiment.

This experiment was started in 1933 on Plot 16 of Kampala Plantation.

*Previous history of plot.*—Up to 1927 it had comprised an observation plot of nearly an acre of leguminosae and of various grasses; an acre of sweet potato varieties and about one-fifth of an acre of cacao. In 1927 the plot was laid down to a Crop Residue experiment<sup>1</sup>.

In 1933 the area was divided into four equal parts, two being planted with Elephant Grass (*Pennisetum purpureum*) and two with *Centrosema pubescens*. The Elephant Grass gave an excellent cover within six months whilst the *Centrosema* grew slowly and had to be weeded several times before a complete stand was obtained.

After October, 1933, the plots were sampled to three depths (0–4", 4–8", and 8–12") at fortnightly intervals for determination of the moisture and nitrate contents. These determinations were continued until February, 1936, when the covers were cut to ground level. One plot of each treatment was burnt over and the residues dug in. On the other two plots the crop was dug in without burning.

The plots were weeded twice before planting with cotton in July, 1936. On the *Centrosema* plots the weeds *Digitaria scalarum* and *Commelina* sp. were difficult to eradicate whilst few weeds had survived on the elephant grass plots.

Moisture and nitrate determination were carried out during the growth of the cover crops up to the beginning of 1936 and the mean of the three values for the three depths were used in each case. During this period the nitrate was higher under the legume than under the grass; whilst the moisture range under the grass is greater than that under the legume and the soil generally drier. These differences were not statistically significant.

After the cover crops received their different treatments, and up to the time when cotton was planted, the nitrate was much higher on the legume plots than on the grass plots, more particularly during dry spells after rain, when the nitrate content was rapidly lowered and the differences were less marked. There is little difference between burning off and digging in in the case of either crop.

When the plot was under the Crop Residue experiment the mean yields of seed cotton in lbs. per acre over the whole experiment for the years 1927–33 inclusive were 150, 570, 243, 194, 149, and 275, by far the best yield occurring in the 1928 season. The yields for that season were extracted from the records and are given in Table VI side by side with those of the corresponding areas during the two seasons after the three years of regeneration.

1. *Ann. Report* (1932) Part II, p. 76.

TABLE VI.—YIELD OF SEED COTTON IN LBS. PER ACRE.

| Plot No.                                                            | C1.  | C2.   | E1.   | E2.   |
|---------------------------------------------------------------------|------|-------|-------|-------|
| 1. 1928-29 .. ..                                                    | 630  | 560   | 475   | 600   |
| 2. 1936-37 .. ..                                                    | 443  | 540   | 582   | 785   |
| 3. 1937-38 .. ..                                                    | 590  | 677   | 539   | 799   |
| Mean of 2 and 3 .. ..                                               | 517  | 608   | 560   | 792   |
| Mean of 2 and 3 expressed<br>as percentage of 1928-29<br>crop .. .. | 82.1 | 112.5 | 117.9 | 131.8 |

Plot C1. *Centrosema pubescens* burnt off.

Plot C2. *Centrosema pubescens* dug in.

Plot E1. Elephant Grass dug in.

Plot E2. Elephant Grass burnt off.

Although caution is necessary in drawing too definite conclusions from an experiment of this nature, nevertheless there is strong evidence of the regenerative effect of both covers and also of indication that Elephant Grass is superior to leguminous cover.

It may be added that soil samples from a plot at Bukalasa cropped for three years compared with samples from a neighbouring plot rested for three years under Elephant Grass showed a substantial difference in organic matter content in favour of the latter plot.

### Effect of Tree Cover on Soil.

Now that the question of the afforestation of certain districts is under active consideration the possibility is being borne in mind that different tree covers may have different effects upon the soil. Much work has been done in other countries in this respect but little of it applies to Uganda trees or conditions. The effect of Eucalyptus is the first which is being studied here, but it is hoped both to systematize the investigation and to extend it to other tree covers as opportunity offers.

### Experiments on Cotton Seed and Cotton Seed Meal as Fertilisers.

#### (1) FIELD EXPERIMENT.

During the year a series of experiments has been carried out to find the effects of applying rotted cotton seed and cotton seed meal in small amounts. Three levels of dressing have been used for each, namely:—

##### A. Cotton Seed.

No dressing. Single dressing 300 lbs./acre.

Double dressing 600 lbs./acre.

##### B. Cotton Seed Meal.

No dressing. Single dressing 150 lbs./acre.

Double dressing 300 lbs./acre.

The layout is a quasi-Latin square and superimposed on the manurial treatments are three different methods of disposal of the residue of the crop after harvest.

(1) Cart off. (2) Burn on plot and scatter ash to dig in and

(3) Dig in all residues.



A close season for cotton is necessary for the control of pests and a date is fixed each year by which all cotton residues have been uprooted and burnt. In view of the difficulty of digging in the cotton residues it has been decided to discard the third disposal treatment except on the main experiment stations.

The yields of the first cotton crop at Serere, Ngetta and Mbale are given in the following table.

TABLE VII.—YIELD OF SEED COTTON IN LBS. PER ACRE.

|             |   | Nil.  | Single Dressing. | Double Dressing. |
|-------------|---|-------|------------------|------------------|
| Serere      | A | 72.7  | 60.6             | 74.3             |
|             | B | 70.6  | 65.8             | 70.4             |
| Mbale       | A | 224.0 | 238.0            | 233.0            |
|             | B | 230.0 | 239.0            | 239.0            |
| Ngetta      | A | 107.0 | 114.0            | 113.0            |
|             | B | 109.0 | 102.0            | 110.0            |
| All Centres | A | 403.7 | 412.6            | 420.3            |
|             |   | 409.6 | 406.8            | 419.4            |

These differences are not significant.

In view of the results of the Kampala pot experiment (*see* below) future dressings will be much heavier and a different index crop will be used. The experiment will be repeated this year using 0, 2 and 4 tons of seed per acre and 0, 1 and 2 tons of meal, with *Sorghum* as an index crop.

With the co-operation of the Cotton Association, pit rotting of cotton seed has been carried out at a number of ginneries. Analysis of rotted seed from Masaka gave the following result:—

|                     |    |    |        |
|---------------------|----|----|--------|
| Moisture            | .. | .. | 44.3 % |
| Ammoniacal Nitrogen | .. | .. | 0.09%  |
| Total Nitrogen      | .. | .. | 1.06%  |
| Loss on Ignition    | .. | .. | 22.30% |

Comparison of these figures with those given later for fresh seed and meal shows that the product has lost a good proportion of its nitrogen, though its mineral value will not be reduced. As nitrogen is probably the most valuable constituent, however, its loss is a serious one.

## (2) POT EXPERIMENT.

The term "pot experiment" needs some qualification. The "pots" in question were 40-gallon steel petrol drums which were being disposed of at a nominal price by a local firm. The size of these drums made possible a nearer approach to field conditions than is usually the case with such experiments.

The pots were arranged contiguously in a compact block consisting of twenty rows of ten with an encircling outside protective row. To lessen temperature and other variation the space between the pots was filled with soil to the brim.

Soil from the Kampala Plantation was used.

The method adopted was to clear a small plot, approximating to the area occupied by the pot experiment, of top soil. The pots were then filled to the brim with subsoil which was watered, allowed to settle, and trampled. When subsidence was completed (or practically so)

the pots were refilled with top soil. Time was allowed for this to settle and more top soil was added to the brim.

*Object of the Experiment.*

The object of the present experiment was to study the effect of cotton seed and cotton seed meal as fertilisers for cotton, and if possible to determine the optimum dressing of each.

*Design of the Experiment.*

The treatments to be applied were:—

|                                        |                                             |
|----------------------------------------|---------------------------------------------|
| Cotton Seed .. $\frac{1}{2}$ lb. /pot. | Cotton Seed Meal .. $\frac{1}{4}$ lb. /pot. |
| Cotton Seed .. 1 lb. /pot.             | Cotton Seed Meal .. $\frac{1}{2}$ lb. /pot. |
| Cotton Seed .. 2 lbs./pot.             | Cotton Seed Meal .. 1 lb. /pot.             |
| Cotton Seed .. 3 lbs./pot.             | Cotton Seed Meal .. 2 lbs./pot.             |
| Cotton Seed .. Nil.                    | Cotton Seed Meal .. Nil.                    |

The treatment of  $\frac{1}{2}$  lb. per pot in this experiment corresponded approximately with 4 tons per acre, calculated on the surface area of the pot.

The ten treatments were replicated in twenty randomised blocks.

Analyses of both were made with the following results:—

|                     | Moisture. | Organic Nitrogen | K <sub>2</sub> O | Ether Extract approx. |
|---------------------|-----------|------------------|------------------|-----------------------|
|                     | %         | %                | %                | %                     |
| Cotton Seed ..      | 9.4       | 3.15             | 1.42             | 21.0                  |
| Cotton Seed Meal .. | 3.4       | 6.85             | 2.32             | 7.8                   |

The fertiliser was in each case intimately mixed with the top soil.

*Effect of Fertiliser Applications on Germination of Cotton.*

Cotton was planted within two days of the application of fertilisers. The effect of the applications upon germination was most marked, resulting in almost complete failure. Those plants which appeared were uprooted and the experiment re-sown. A similar though reduced effect on germination resulted. Planting was repeated a third and finally a fourth time. The effect on germination is summarised in the following table.

TABLE VIII.—NUMBER OF POTS IN WHICH GERMINATION OCCURRED AFTER TEN DAYS.

| Date of sowing. |    | Treatment. |               |     |      |    |                  |               |      |   |  |
|-----------------|----|------------|---------------|-----|------|----|------------------|---------------|------|---|--|
|                 |    | None.      | Cotton Seed   |     |      |    | Cotton Seed Meal |               |      |   |  |
|                 |    |            | lbs.          | per | pot. |    | lbs.             | per           | pot. |   |  |
|                 |    |            | $\frac{1}{2}$ | 1   | 2    | 3  | *                | $\frac{1}{2}$ | 1    | 2 |  |
| 29-6-37         | .. | 38         | 10            | 7   | 2    | 1  | 5                | 3             | 1    | 0 |  |
| 7-7-37          | .. | 36         | 13            | 13  | 8    | 1  | 19               | 16            | 1    | 0 |  |
| 14-7-37         | .. | 39         | 13            | 13  | 15   | 6  | 20               | 18            | 14   | 1 |  |
| 26-7-37         | .. | 29         | 18            | 19  | 17   | 17 | 19               | 19            | 15   | 2 |  |

NOTE.—There were twenty pots of each of the treatments and forty of the *No treatment*.

By the fourth planting germination was normal in all pots except the ones which had been treated with the heaviest dressing of cotton seed meal, and except also those which had received no treatment. The latter may be explained by the fact that dry weather had set in by the last planting date and the "no treatment" pots suffered

consequently from drought. The treated pots retained their soil moisture to a greater extent.

The effect of the applications on germination is startling and indicates that caution must be exercised in applying dressings of as little as four tons per acre of cotton seed, or two tons of meal. This has since been confirmed by experience on Lugazi Sugar Estate, where cane setts failed to germinate when planted in holes containing cotton seed.

Owing to the intervention of other work the reason for the adverse effect on germination was not definitely established. Seeds which were examined had in some cases failed to make any growth, in other cases the radicle had just emerged and died. The odour of ammonia, however, was most marked and a rough test showed the pH of the soil to have been raised temporarily from about 6.0 to over 8.0. This effect disappeared in about a month. There seems very little doubt therefore that the failure of germination was due to the toxic effect of the ammonia.

This evolution of ammonia is serious, not only from its possible danger to growth, but principally from the implication that a considerable loss, of what is possibly the most valuable manurial constituent, is taking place. A similar, or possibly greater, loss is to be expected if cotton seed is rotted prior to application (*see analysis of pit rotted seed above*). Experiments are now under discussion to determine the extent of these losses and how they may best be avoided.

#### *Effect of Treatments on Flowering and Ripening.*

There were indications that flowering was accelerated by the treatments but the effect was not great and as it was not reflected in the rate of ripening of the crop it was disregarded.

#### *Effect of Treatment on Yields.*

The total yield of seed cotton from each plot was used for the statistical analysis; there was no correlation between yield of clean seed cotton (*safi*) and treatment.

The statistical analysis was carried out by Mr. C. G. Hansford. As previously indicated there was a large percentage of blanks in some of the treatments, and Mr. Hansford calculated the "missing plots" by Yates' method to the second approximation. The results of his analysis are expressed in the following table.

TABLE IX.—MEAN YIELD PER TREATMENT IN GRMS. SEED COTTON.

|                |    |        |                    |          |
|----------------|----|--------|--------------------|----------|
| No treatment   | .. | 51.93. |                    |          |
| Cotton Seed.—  |    |        | Cotton Seed Meal.— |          |
| ½ lb. per pot  | .. | 53.60  | ¼ lb. per pot      | .. 62.75 |
| 1 lb. per pot  | .. | 61.20  | ½ lb. per pot      | .. 62.45 |
| 2 lbs. per pot | .. | 64.50  | 1 lb. per pot      | .. 71.00 |
| 3 lbs. per pot | .. | 66.80  |                    |          |

The least significant difference between controls and any other treatment was found to be 10.45. Those yields which are significantly greater than the control are italicised.

### Discussion of Results.

A significant increase in yield was thus obtained with 16 tons per acre (2 lbs. per pot) and over of cotton seed and with all dressings of cotton seed meal. (The effect of 16 tons per acre of cotton seed meal was disregarded as all pots failed except three).

In accepting this result three points must be borne in mind, namely:—

1. Each plant has been separately studied and is equivalent to a plot on the field scale. Therefore the above comparisons refer to plots in which a perfect stand of cotton was obtained. Had the experiment actually been conducted on the field scale the effect of the treatments on yield per plot would have been greater as the failure of germination on the untreated plots was most marked in the final planting.

2. The average yield of cotton on the untreated plots was equivalent to about 1,200 lbs. (total) per acre at the same spacing. This is a good yield and indicates in itself little need for manuring. Had the experiment been carried out on one of the lighter soils of the Eastern Province a different result might have been obtained. It must be noted, however, that five tons per acre of farmyard manure failed to give an increase of cotton crop in the fertility experiment at Serere this season. (The soil actually used in the pot experiment had *in situ* been a poor one, but the process of transferring it to the pots gave it better aeration and better penetrability).

3. The very large losses of ammonia which took place (as referred to above in connection with the effect on germination) makes it highly doubtful to what, in fact, each dressing was finally equivalent in terms of nitrogen. (See also analysis of pit rotted seed).

In March, 1938, without further addition of fertilisers, the pots were planted with dwarf maize. This was harvested at the end of June and the results are expressed in the following table.

TABLE X.—MEAN YIELD PER TREATMENT IN GRMS. OF MAIZE.

|                           |    |       |       |                           |          |
|---------------------------|----|-------|-------|---------------------------|----------|
| Controls                  | .. | ..    | 82.9. |                           |          |
| Cotton Seed.—             |    |       |       | Cotton Seed Meal.—        |          |
| $\frac{1}{2}$ lb. per pot | .. | 91.7  |       | $\frac{1}{4}$ lb. per pot | .. 103.5 |
| 1 lb. per pot             | .. | 118.6 |       | $\frac{1}{2}$ lb. per pot | .. 110.5 |
| 2 lbs. per pot            | .. | 110.7 |       | 1 lb. per pot             | .. 119.6 |
| 3 lbs. per pot            | .. | 122.0 |       | 2 lbs. per pot            | .. 131.4 |

The least significant difference between controls and any other treatment was 12.6, and between treatments was 14.5.

There has thus been a significant increase with all treatments except the smallest dressing of cotton seed. The season was a difficult one, ending in a drought and it is probable that in a normal season the differences would have been greater. Height measurements taken a month after planting showed highly significant differences with all treatments.



From the appearance of the plants there was little doubt that the residual effect of the treatments on the maize was due to the nitrogen. The experiment will be followed up, if possible, by determinations of nitrogen of the soils in order to establish the actual amount of added nitrogen remaining. The experiment will also be resown with cotton this season without the further application of fertilisers.

### *Summary of Conclusions.*

1. The application of cotton seed or meal directly to the land results in a considerable loss of nitrogen. A similar loss is to be expected when the seed or meal is rotted prior to application, though in the latter case danger to the crop from excessive evolution of ammonia is avoided.

2. In this experiment cotton did not respond to the manurial treatments as well as did the maize which followed.

## **An Investigation into the Nutrient Status and Reaction of the Coffee Soils of the Western Province.**

This investigation was undertaken in the first place in order to examine the suggestion that the infestation of *Antestia lineaticollis* was affected by soil factors. As, however, the problems connected with *Antestia* are now being examined in detail by the Entomologist it has been decided in the present report to avoid reference to the entomological side of the investigation. The chief immediate value of the present work lies in the demonstration of attack of field problems connected with the soil.

### **DESCRIPTION OF METHODS USED.**

#### *Choice of Plots for Examination.*

From considerations of time the coffee plots examined were mostly within reasonable walking distance of motor roads, as in order to obtain sufficiently large groups of samples it was necessary to aim at examining twenty plots per day.

The selection of plots could not be altogether at random for two reasons, namely (a) the scarcity of plots in parts of Ankole, and (b) the original purpose of the investigation referred to above made it desirable to sample plots close together if well marked differences existed in any factor which might prove to be relevant.

#### *Method of Examination of Soil Samples.*

Soil samples were taken in each plot examined with an auger. When the depth of soil permitted, two samples were taken, from 0 to 8" and from 8" to 16". When a convenient number of samples had been accumulated a day was set aside for their examination.

#### *Determination of pH.*

The pH value of all samples was first determined by the spoon method using B.D.H. Universal Indicator. This was followed in the case of the 0-8" samples by a more accurate determination with a specific

indicator using the Lovibond Comparator, the soil water suspensions having been clarified with Barium Sulphate.

Determinations were in all cases carried out on the undried soil. There are indications that lower pH values would have been obtained had the samples first been dried. Attention is now being given to the magnitude of such differences. The method used for the colorimetric determination has also been criticised and is now under review. It may, however, be stated that only the absolute pH values will be affected if it is found necessary to apply a correction. The general nature of the conclusions arrived at will be unaltered.

#### *Determination of Available Nutrients (Phosphate, Potash and Calcium).*

The methods used were essentially those described by Spurway<sup>1</sup>. An acetic acid extract of the soil was prepared and 1 ml. of this extract was taken for the determination of Phosphate, Potash and Calcium. These involve respectively the development of a blue colour with tin and ammonium molybdate, the production of a precipitate with sodium cobaltinitrite, and with ammonium oxalate. Spurway recommends comparison with standard charts but in the present investigation it was found more satisfactory for the operator to form his own estimate and to record it as a decimal assessment taking 0 for his minimum and 5 for his maximum.

These methods were adopted after a preliminary examination in the laboratory of over seventy soils by the rapid field methods as described and also by the standard methods as used in the Kampala laboratories, the agreement between the results of the two methods being excellent. (Note on Rapid Tests, G. Griffith, *J. Soc. Chem. Ind.*, 1938, p. 211).

#### *General Note on Examination of Soils.*

In the case of each determination the operator was unaware of the identity of the soil which he examined. This is considered to be a vital precaution in carrying out work of this nature in that the personal error is thus reduced to a minimum.

#### *Field Observations.*

Other observations made on each plot included altitude, aspect, slope, exposure, variety of coffee, age and height of tree, spacing, crop, extent and nature of ground cover and incidence of *Antestia*.

As has been stated above it has been decided to avoid reference for the present to the bearing of the investigation upon the last named, and a detailed account of the observations is therefore omitted.

#### *Discussion of Results.*

A total of 400 plots was examined in the three districts of Kigezi, Ankole and Toro. Mr. C. G. Hansford carried out a statistical analysis of the data, and the conclusions arrived at are summarised in the following table.

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1. C. H. Spurway *Michigan State University Journal*.

TABLE XI.—MEAN SOIL CHARACTERS.

| District.             |    |    | Clean Weeded. | Type of Cover. |        | Mean. |
|-----------------------|----|----|---------------|----------------|--------|-------|
|                       |    |    |               | Mulched.       | Weeds. |       |
| PH VALUE OF TOP SOIL. |    |    |               |                |        |       |
| Kigezi                | .. | .. | 6.28          | 6.40           | 6.28   | 6.32  |
| Ankole                | .. | .. | 6.12          | 6.25           | 6.26   | 6.31  |
| Toro                  | .. | .. | 6.13          | 6.42           | 6.39   | 6.31  |
| Means                 | .. | .. | 6.18          | 6.35           | 6.31   | 6.28  |
| PHOSPHATE.            |    |    |               |                |        |       |
| Kigezi                | .. | .. | 0.80          | 1.65           | 0.73   | 1.06  |
| Ankole                | .. | .. | 1.33          | 1.66           | 1.60   | 1.53  |
| Toro                  | .. | .. | 1.57          | 2.56           | 2.70   | 2.28  |
| Means                 | .. | .. | 1.24          | 1.96           | 1.67   | 1.62  |
| POTASH.               |    |    |               |                |        |       |
| Kigezi                | .. | .. | 0.47          | 0.98           | 0.36   | 0.60  |
| Ankole                | .. | .. | 0.96          | 1.62           | 1.64   | 1.41  |
| Toro                  | .. | .. | 1.07          | 1.72           | 1.64   | 1.48  |
| Means                 | .. | .. | 0.83          | 1.44           | 1.21   | 1.16  |
| CALCIUM.              |    |    |               |                |        |       |
| Kigezi                | .. | .. | 1.47          | 1.89           | 1.36   | 1.57  |
| Ankole                | .. | .. | 1.29          | 1.40           | 1.57   | 1.42  |
| Toro                  | .. | .. | 1.71          | 2.32           | 2.27   | 2.10  |
| Means                 | .. | .. | 1.49          | 1.87           | 1.74   | 1.70  |

The differences between the three districts are significant. In the case of phosphate Toro > Ankole > Kigezi, in that of potash Kigezi is significantly the lowest, and in the case of calcium Toro is significantly the highest. It may be as well to repeat that the figures given in Table XI for the available nutrients do not refer to actual percentages, but are derived from assessment by the rapid tests.

The richest soils are to be found in the Burahya and Bunyangabo Counties of Toro, the poorest in Kigezi. It may be noted that the soils of Bufumbira County in Kigezi are by no means as rich as volcanic soils are popularly supposed to be. The main deficiency in Bufumbira County appears to be in potash.

#### *The Effect of Mulching.*

The position as regards mulching may be regarded on the whole as satisfactory, as will be seen from Table XII.

TABLE XII.

| District. |    |    | No. of plots examined. | No. mulched. | Percentage mulched. |
|-----------|----|----|------------------------|--------------|---------------------|
| Kigezi    | .. | .. | 145                    | 108          | 75                  |
| Ankole    | .. | .. | 177                    | 99           | 56                  |
| Toro      | .. | .. | 78                     | 33           | 42                  |

The percentage mulched in Kigezi, though high, is much reduced by the dislike of the practice in Rukiga County where *Antestia* is bad, and where the popular belief is that mulching increases the infestation. In other parts of Kigezi the percentage of mulched plots is very high indeed, and the mulch exceptionally well applied. The Toro figure for mulching is reduced by the number of abandoned and semi-abandoned European owned estates in that district.

It may be noted with respect to Ankole that though mulching is not carried out as extensively as in Kigezi this is compensated for to some extent by the growing practice of applying kraal manure to the plots.

pH, phosphate, potash and calcium are all significantly higher under mulch than on the clean weeded plots. The effect of mulch on the nutrients is interesting, and not unexpected. Two factors operate, namely the increase of available nutrients under mulch and the loss of top soil under clean weeded conditions. The effect of the latter on the pH is predictable as in this country it is the general experience that acidity increases with depth.

Notable quantities of both phosphate and potash are, of course, added to the soil by mulching, and there is also an increase in their availability following the enrichment of the soil in organic matter. The effect on the calcium is not so marked as the quantity added in the mulch is comparatively small. It was found that the percentage differences between mulched and clean weeded plots were respectively phosphate 60%, potash 75%, calcium 25%.

#### *Correlation between pH Value and Nutrient Content.*

The following coefficients were obtained: pH with phosphate 0.53, with potash 0.48, and with calcium 0.50, showing a high degree of correlation, which is in accord with general experience in Uganda.

#### **Tea Soils.**

A preliminary reconnaissance of the soils under tea has been made during the year. There has been a considerable extension of tea growing in this country and many of the areas examined had only recently been planted.

On the areas in bearing yield figures and exact information on quality were not obtainable, so that the results give no indication at present on the relation of soil to these factors. It has only been possible to say that in general the new areas conform approximately in soil characters to the Mityana area which has been proved to grow tea with success.

In accordance with experience in other countries tea has consistently failed on sites previously occupied by houses or kraals. Soils from such sites have without exception been found to be richer in available nutrients than the neighbouring soils, and have either been neutral or alkaline.

#### **Native Foodstuffs.**

Foodstuffs dealt with in the course of the year have been bulo (*Eleusine coracana*) and soy bean. The bulo was examined in response to an enquiry as to the effect of storage upon its food properties. The results are given in the following table.



TABLE XIII.—ANALYSES OF BULO (*Eleusine coracana*) (FORT PORTAL).

| Year.                         | 1934. | 1935. | 1936. | 1937. |
|-------------------------------|-------|-------|-------|-------|
| Moisture .. ..                | 13.1  | 13.9  | 13.3  | 13.5  |
| Ash .. ..                     | 7.2   | 2.5   | 4.4   | 3.3   |
| Fat .. ..                     | 0.83  | 0.97  | 0.91  | 0.89  |
| Crude Protein ...             | 6.50  | 6.08  | 6.77  | 7.23  |
| Fibre .. ..                   | 2.83  | 2.26  | 2.87  | 2.49  |
| Carbohydrate by difference .. | 69.5  | 74.3  | 71.7  | 72.6  |

No effect of storage appears and in fact the 1935 sample was the best in appearance. The high ash in the 1934 sample was due to admixture with soil.

The soy beans were grown at Bukalasa. Their analyses were as under:—

#### SOY BEANS (BUKALASA).

| Variety.         | Palmetto. | R 184. | R 42.        | R 51. | Local. | Barberton |
|------------------|-----------|--------|--------------|-------|--------|-----------|
|                  |           | Dept.  | Agric. Union | S.A.  |        |           |
| Moisture ..      | 10.2      | 10.0   | 9.9          | 9.8   | 9.6    | 9.4       |
| Ash ..           | 5.5       | 5.5    | 5.4          | 5.0   | 5.4    | 5.7       |
| Fat ..           | 16.4      | 17.2   | 19.8         | 20.8  | 19.2   | 19.2      |
| Crude Protein .. | 37.0      | 34.2   | 31.8         | 33.4  | 33.1   | 32.4      |

#### Essential Oils.

There has been little public interest taken in essential oils and work has been confined to lemon grass and vetivert. Experiments on the former are in progress to determine the frequency of cutting that may be possible and on the latter to determine at what age to uproot. Complete results are not yet available from either crop.

#### Cotton Seed Oil.

Reference has been made in past reports to investigations which are being carried out on the local utilisation of cotton seed. Experiments have been made during the year to determine the fertilising value of the seed, but it is realised that the local use of the seed as fertiliser will be greatly encouraged if a profitable outlet is first found for the oil.

Reports on the possibility of using this oil as Diesel fuel have now been received and are encouraging. It is necessary to confirm that results obtained in England are reproducible in Uganda, and to this end ninety gallons of oil were this year prepared and handed over to the Public Works Department for experimental purposes.

This quantity of oil represents a yield of 11% of the original seed, and as the proper machinery was not available it is safe to say that this yield could be substantially increased.

Our thanks are due to Messrs. Jamal Ramji and Co., Ltd., of Kampala for their valuable assistance in this work.

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## REPORTS OF THE BOTANICAL SECTION.

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### (i) REPORT OF THE SENIOR BOTANIST, BUKALASA.

#### Meteorology.

General conditions were extremely dry particularly during the planting and growing months. Although the total rainfall for the year at Bukalasa was normal the distribution was bad, for example, in July, one of the critical planting months, out of a total of 4.15 inches 2.10 fell on one day. August rainfall was very short, in fact cotton planting was only possible on two days in this month.

The harvesting season was also very dry with the result that while the grade was good no second crop was formed except in the earliest sown cotton. This dry spell caused a drop in staple length, local samples being at least 1 mm. shorter than in the previous season. The fact that yields were good despite the dry weather again emphasised that cotton can stand considerable periods of drought and is generally freer from disease under such conditions.

#### Cotton Breeding Work.

##### (1) *Field Selections for 1938/39 Season.*

More field selections than usual have been received, but unfortunately very few of them have a lint length anything approaching the minimum of 30 mm. It has often been remarked here and elsewhere that a large field for selection is available in local Buganda cotton. While this is certainly true with regard to habit, disease resistance, etc., it is becoming increasingly apparent that the field is very limited as far as lint quality is concerned. The Mass selection plots at Bukalasa where local cotton is being "Mass selected" for lint length provide a sorry picture and only an occasional plant has a reasonable lint length. It would appear that there is a definite shortage of 1-3/16ths cottons. and material, within which selection is possible, is very limited indeed.

##### (2) *New Selections.*

The most interesting feature of this group was the high percentage of Wilt infection and at the same time the apparent resistance of some lines. B.347, a derivative of B.P.50, selected for recovery from Wilt in the previous season, had only one plant infected, and in addition it was highly resistant to Black Arm.

B.356, a selection from B.P.52, promised well as it remained completely free from Black Arm, a distinction lacked by B.P.52 itself. It gave the highest yield of any line in the breeding plot, averaging 61 bolls per plant, while the ginning percentage of 34 was considerably higher than that of B.P.52,

The following table gives the 1937/38 rainfall for the various variety trial centres, etc.

### Rainfall (inches).

|                                   | Bukalasa.<br>(hours<br>sunshine<br>per day). | Kawanda<br>(seed<br>farm). | Ntenjeru<br>(proposed<br>Segregated<br>Area). | Kalagala. | Mukono. | Kaba-<br>sanda. | Nkozi. | Kalungu. | Kyana-<br>mukaka. |
|-----------------------------------|----------------------------------------------|----------------------------|-----------------------------------------------|-----------|---------|-----------------|--------|----------|-------------------|
| <b>1937.</b>                      |                                              |                            |                                               |           |         |                 |        |          |                   |
| March                             | 6.20                                         | 2.88                       | 4.55                                          | 4.36      | 3.09    | 3.63            | 6.18   | 5.37     | 7.73              |
| April                             | 5.52                                         | 9.17                       | 11.78                                         | 4.67      | 7.15    | 8.07            | 6.14   | 3.71     | 9.47              |
| May                               | 5.44                                         | 9.03                       | 3.77                                          | 7.86      | 9.02    | 8.51            | 8.81   | 2.75     | 8.91              |
| June                              | 3.12                                         | 1.86                       | 1.58                                          | 6.64      | 3.41    | 1.62            | 1.53   | 1.38     | 0.22              |
| July                              | 4.09                                         | 3.14                       | 1.48                                          | 3.49      | 2.42    | 1.00            | 3.55   | 1.82     | 2.17              |
| August                            | 1.70                                         | 2.04                       | 2.10                                          | 0.84      | 1.47    | 0.27            | 0.37   | 0.83     | 1.59              |
| September                         | 5.08                                         | 4.43                       | 2.34                                          | 2.32      | 3.51    | 6.38            | 3.46   | 1.65     | 3.50              |
| October                           | 4.70                                         | 4.73                       | 3.17                                          | 5.52      | 4.47    | 4.71            | 3.48   | 3.33     | 5.22              |
| November                          | 6.76                                         | 6.99                       | 6.27                                          | 5.76      | 8.88    | 11.00           | 7.07   | 6.09     | 4.64              |
| December                          | 2.59                                         | 2.38                       | 2.92                                          | 2.48      | 2.80    | 2.75            | 3.68   | 3.19     | 3.48              |
| <b>1938.</b>                      |                                              |                            |                                               |           |         |                 |        |          |                   |
| January                           | 0.41                                         | 0.29                       | 0.39                                          | 0.35      | 2.05    | 0.33            | 0.50   | 0.52     | 3.48              |
| February                          | 1.55                                         | 0.35                       | 1.18                                          | 0.96      | 1.99    | 0.60            | 0.65   | 0.87     | 1.44              |
| TOTAL                             | 47.16                                        | 47.29                      | 41.53                                         | 45.25     | 50.26   | 48.87           | 45.42  | 31.51    | 51.85             |
| Number of days on which rain fell | 170                                          | 134                        | 146                                           | 139       | 159     | 92              | 122    | 75       | 88                |

### (3) *Pedigree Lines.*

Bulk selections from B.P.52 derivatives for Black Arm resistance showed no resistance this season and all suffered severely from the disease. B.P.50 derivatives were satisfactory but were low yielding. U.4 derivatives which had been selected for lint length were nearly all severely attacked by Black Arm and in one of them 80% of the plants were infected with Wilt.

B.181 derivatives (a local selection) were very promising for habit, hairiness, yield and resistance to Black Arm and Wilt, but there seems to be little chance of obtaining a strain with suitable lint. B.P.168 was the only one which had anything approaching a reasonable length and this, as usual, was accompanied by a reduction in ginning percentage.

S.G.23/8 derivatives were short linted but yielded well and were remarkably free from Black Arm and Wilt. An example of the instability of some types is given by B.P.197—which is the result of thirteen generations of single plant selection from S.G.23. Although it is uniform for most characters it is still splitting for seed type and this year gave a ratio of naked seed to fuzzed seed of 2.9:1.

It is noticeable too that both the S.G.23/8 derivatives retained the low boll shedding percentage character of S.G.23/8.

### Mass Selections.

Last season's report referred to a start having been made to improve ordinary Local by Mass selection. All plants with a lint length of under 30 mm. all wilted plants and all plants severely attacked by Black Arm, were rogued out. Sufficient selfed seed was obtained from the remaining plants for a  $\frac{1}{4}$ -acre increase plot, a  $\frac{1}{10}$ th acre rogueing plot and a variety trial with ordinary Local. The results from the variety trial are encouraging as there were definite indications that Mass selection has improved staple length, and uniformity of staple.

The following table summarises the results:—

|                                                   | Ordinary Local | Mass Selected | Level of Significance |
|---------------------------------------------------|----------------|---------------|-----------------------|
| Yield Seed Cotton (lbs. per acre)                 | 1,199          | 1,137         | $P = .05$             |
| Ginning % .. ..                                   | 30.3           | 30.5          |                       |
| Yield Lint (lbs. per acre) ..                     | 363            | 347           | none                  |
| Lint Length (mm.) .. ..                           | 25.94          | 27.68         |                       |
|                                                   | $\pm 0.34$     | $\pm 0.23$    | $P < .01$             |
| Black Arm 3-12-37 (total lesions per plant) .. .. | 3.20           | 2.75          | none                  |

Further rigid rogueing was done within the Mass selected bulk and the lint length of the remaining plants was  $29.76 \pm 0.19$  with a ginning outturn of 29.4%.

### Mixture.

Reference was made last year to the possibilities of a controlled mixture of strains. It has been possible to test the second stage of the mixture in the district variety trials this season and the results both



The following table presents the more interesting details of the Pedigree Lines:—

| Group and Origin.                    | Pedigree.                                | Bolls per Plant.             | % Bolls shed.        | B.A. Lesions per Plant.  | % age Plants infected Wilt. | Lint Length. mm.             | Ginning Outturn. %           |
|--------------------------------------|------------------------------------------|------------------------------|----------------------|--------------------------|-----------------------------|------------------------------|------------------------------|
| B.P.52 .. ..                         | B.P.116.V<br>B.P.173                     | 25.3<br>39.9                 | ..<br>66             | 2.6<br>1.3               | 19.5<br>2.3                 | 30.6<br>30.4                 | ..<br>31.1                   |
| B.181 .. ..                          | B.P.167<br>B.P.168<br>B.P.169<br>B.P.172 | 36.2<br>34.6<br>32.3<br>34.7 | 54<br>57<br>45<br>50 | 0.1<br>Nil<br>0.2<br>0.9 | 18.0<br>8.5<br>5.0<br>2.0   | 27.7<br>28.8<br>26.9<br>27.9 | 32.9<br>31.7<br>32.3<br>32.2 |
| B.P.50 .. ..                         | B.P.176<br>B.P.177<br>B.P.182            | 27.5<br>31.3<br>29.4         | 61<br>60<br>60       | 0.2<br>0.3<br>0.8        | Nil<br>Nil<br>4.5           | 29.7<br>30.0<br>30.0         | 33.2<br>32.3<br>31.5         |
| U.B.24/4 ..<br>(U.4/130 S. Rhodesia) | B.P.185<br>B.P.186                       | 25.6<br>25.2                 | ..<br>59             | 3.5<br>0.2               | Nil<br>2.2                  | 29.6<br>30.1                 | 32.6<br>32.4                 |
| S.G.23/8 .. ..                       | B.P.195<br>B.P.197                       | 44.5<br>41.4                 | 46<br>46             | 0.1<br>0.02              | Nil<br>4.2                  | 28.1<br>27.6                 | 32.0<br>30.6                 |

as regards yield and quality are satisfactory. Spinning Tests on the first stage of the Mixture were very encouraging, in fact the results were as good as those of B.P.52.

### Hybrids.

A large number of F1's were grown, the most useful of which were two between B.P.52 and B.181. In each case the Black Arm resistance of B.181 showed dominance. Parent rows were grown on each side of the F1's which afforded easy comparison. In all cases where differences in maturity between parents were well defined, the F1's showed dominance of early maturity.

Numerous Back Crosses were made, particularly with the B.P.52 × B.181 F1's as these should provide useful material.

Three lots of Back Crosses were grown, the two of most interest being—

BX 1 BC 1 = (S.G.23·8 × B.P.79) × (B.P.79) and

BX 1 BC 2 = (S.G.23·8 × B.P.79) × (S.G.23·8).

The effect of the double dose of each parent was pronounced for lint length.

|           |    | Lint Length. |    |    | Ginning Outturns. |
|-----------|----|--------------|----|----|-------------------|
|           |    | mm.          |    |    |                   |
| S.G.23·8  | .. | 27·0         | .. | .. | 31·0              |
| B.P.79    | .. | 30·2         | .. | .. | 31·4              |
| BX 1 BC 1 | .. | 30·7         | .. | .. | 30·9              |
| BX 1 BC 2 | .. | 27·3         | .. | .. | 31·8              |

Three lots of F3's were grown from the S.G.23/8 × B.P.79 cross. Considerable uniformity in ginning outturn and lint length was obtained in Nos. 1 and 3, both of which were satisfactory as far as these characters were concerned. All were rather susceptible to Black Arm, No. 2 being the worst in this respect. No. 2 also was short stapled and of very little value.

|            |    | Lint Length<br>mm. | Ginning<br>Outturn. | Bolls<br>per plant. | Black Arm<br>Lesions<br>per plant. | Wilt. |
|------------|----|--------------------|---------------------|---------------------|------------------------------------|-------|
| BX 1 F 3.1 | .. | 31·2               | 32·4                | 30·9                | 0·85                               | Nil.  |
| BX 1 F 3.3 | .. | 31·6               | 31·6                | 27·1                | 1·59                               | Nil.  |
| S.G.23/8   | .. | 27·0               | 31·0                | ..                  | 5·00                               | Nil.  |
| B.P.79     | .. | 30·2               | 31·4                | ..                  | 1·20                               | Nil.  |

### Variety Trials.

(1) *The Main Variety Trial* at Bukalasa consisted of the usual 8 by 8 Latin Square, the eight varieties being:—

Local (control).

B.P.52 (Nyasaland Upland origin).

X (B.P.79 + S.G.23/8 + B.P.52).

B.P.104 (Nyasaland Upland *via* S.G.23/8).

B.181 (Local selection).

U.B.24/4 (U.4/130 from S. Rhodesia).

S.P.84 (U.4.4.2 = from Serere).

S.P.102 (S.G.29 hybrid from Serere).

*Habit.*—All varieties stood up well and there was little tendency to go to wood. Local had the worst habit and S.P.102 the best.

*Black Arm.*—Considerable variation in Black Arm occurred and this season was a useful test as it was the worst Black Arm season in Buganda since 1929. B.181, S.P.84, S.P.102 and B.P.104 all showed high resistance. B.P.52 and U.B.24/4 were definitely susceptible.

| Variety.   | Total Lesions<br>per Plant. | Variety.  | Total Lesions<br>per Plant. |
|------------|-----------------------------|-----------|-----------------------------|
| B.181 ..   | 0.20                        | Local ..  | 2.54                        |
| S.P.102 .. | 0.50                        | X ..      | 3.10                        |
| S.P.84 ..  | 0.87                        | B.P.52 .. | 4.28                        |
| B.P.104 .. | 1.41                        | U.B.24/4  | 4.76                        |

Significant differences (analysis by logarithmic transformation):—

B.181 < S.P.102 < S.P.84 < B.P.104 < Local and X.

U.B.24/4 and B.P.52 > Local.

These results were expected and inspection of the yields shows that B.P.52 has yielded well despite high Black Arm infection. As in previous years this variety appears to tolerate Black Arm.

*Wilt.*—A very heavy infection of Wilt occurred on the trial and it was particularly noticeable that the bottom row of plots was the worst affected. This is demonstrated by B.P.52, in which out of a total number of infected plants of 274, no less than 195 occurred in the plot in the bottom row.

Monthly counts of infection were made and B.181 had significantly fewer wilted plants than Local, S.P.102 and S.P.84. These counts were made on the basis of external symptoms of the disease. At the end of the season every plant in the trial was uprooted and examined for internal symptoms of Wilt and it was found that a large number of plants were infected without exhibiting the normal external symptoms. The following table shows the summary of the two methods of counts:—

| Variety.       | Plants showing<br>External Symptoms. | Plants infected<br>with Wilt. |
|----------------|--------------------------------------|-------------------------------|
| B.181 .. ..    | 16 (all in one plot)                 | 212                           |
| U.B.24/4 .. .. | 24 .. ..                             | 152                           |
| B.P.104 .. ..  | 35 .. ..                             | 260                           |
| X .. ..        | 51 .. ..                             | 208                           |
| S.P.84 .. ..   | 70 .. ..                             | 322                           |
| B.P.52 .. ..   | 70 .. ..                             | 274                           |
| Local .. ..    | 117 .. ..                            | 498                           |
| S.P.102 .. ..  | 136 .. ..                            | 418                           |

S.P.102 and Local were the most susceptible varieties, over 25% of the total number of plants being infected in these two varieties.

*Earliness.*

The earliest maturing variety was U.B.24/4 followed by S.P.102, B.P.52 and S.P.84. B.P. 104 and B.181 were late maturing.

*Yields.*

The fact that it was a high yielding season was responsible for a general levelling up of the varieties; in fact the only significant differences in yields of seed cotton were B.181 which gave a higher yield than all other varieties and U.B.24/4 which gave a lower yield than all others.

The percentage of stained cotton was very low. B.181 being the best in this respect with only 2.4% and U.B.24/4 the worst with 6.4%.

Lint yields changed the picture somewhat owing to the high ginning outturn of S.P.84. This variety gave significantly more lint than any variety except B.181—the latter again being better than all other varieties.

*Lint Length.*

In general the varieties gave shorter staple than last season owing to the prolonged dry weather. Local was shorter than any previous sample of Local Buganda examined at Bukalasa. B.181 was disappointingly short and rough and B.P.52 was the only variety to come up to the 30 mm. minimum.

*Table Summarising Results (Yields in Lbs. per Acre).*

| Variety.                        | Yield Seed Cotton. | Percentage Stained Cotton. | Yield of Lint. | Ginning Percentage. | Lint Length mm. |
|---------------------------------|--------------------|----------------------------|----------------|---------------------|-----------------|
| B.181 .. ..                     | 1,605              | 2.4                        | 510            | 31.9                | 27.14           |
| B.P.104 .. ..                   | 1,405              | 3.6                        | 414            | 29.5                | 28.24           |
| Local .. ..                     | 1,400              | 3.7                        | 415            | 29.7                | 25.83           |
| S.P.84 .. ..                    | 1,365              | 4.7                        | 471            | 34.5                | 27.96           |
| B.P.52 .. ..                    | 1,360              | 4.9                        | 411            | 30.2                | 30.25           |
| X .. ..                         | 1,330              | 5.3                        | 414            | 31.1                | 29.38           |
| S.P.102 .. ..                   | 1,310              | 5.1                        | 426            | 32.5                | 28.43           |
| U.B.24/4 .. ..                  | 1,150              | 6.4                        | 357            | 31.0                | 28.39           |
| Least Significant Difference .. | 115.5              | ..                         | 37.2           | ..                  | ..              |

*(2) District Variety Trials.*

These were conducted at the same centres as last season with one additional centre at Bukomero. The yield figures from Mukono and Nkozi had to be discarded as unreliable.

*Total Seed Cotton: Lbs. per Acre.*

|                | Local. | B.P.52. | B.P.104. | X     | Least Significant Difference. |
|----------------|--------|---------|----------|-------|-------------------------------|
| Bukalasa ..    | 1,285  | 1,088   | 1,247    | 1,083 | 136                           |
| Kalagala ..    | 1,070  | 621     | 821      | 808   | 73                            |
| Bukomero ..    | 745    | 1,001   | 704      | 971   | 181                           |
| Kabasanda ..   | 1,091  | 1,129   | 1,081    | 1,110 | ..                            |
| Kalungu ..     | 623    | 447     | 587      | 557   | 149                           |
| Kyanamukaka .. | 780    | 714     | 709      | 616   | ..                            |
| Six Centres .. | 932    | 833     | 858      | 858   | 61                            |



*Ginning Percentage.*

|               |    | Local. | B.P.52. | B.P.104. | X    | Least Significant Difference. |
|---------------|----|--------|---------|----------|------|-------------------------------|
| Bukalasa      | .. | 29.7   | 30.2    | 29.5     | 31.1 | Bulk samples only.            |
| Kalagala      | .. | 28.9   | 31.2    | 29.6     | 31.2 |                               |
| Mukono..      | .. | 30.1   | 32.1    | 30.1     | 32.1 |                               |
| Bukomero      | .. | 30.1   | 31.8    | 30.3     | 32.7 |                               |
| Kabasanda     | .. | 29.6   | 30.3    | 29.8     | 31.2 |                               |
| Nkozi ..      | .. | 29.2   | 30.7    | 29.6     | 31.6 |                               |
| Kalungu       | .. | 29.6   | 30.7    | 30.1     | 32.9 |                               |
| Kyanamukaka   | .. | 30.9   | 31.6    | 30.3     | 32.7 |                               |
| Eight Centres | .. | 29.8   | 31.1    | 29.9     | 31.9 |                               |

*Lint: Lbs. per Acre (as obtained from two foregoing tables).*

|                |     |     |     |     |    |
|----------------|-----|-----|-----|-----|----|
| Bukalasa ..    | 382 | 329 | 368 | 337 | 41 |
| Kalagala ..    | 309 | 194 | 243 | 252 | 22 |
| Bukomero ..    | 224 | 318 | 213 | 318 | 57 |
| Kabasanda ..   | 323 | 342 | 322 | 346 | .. |
| Kalungu ..     | 184 | 137 | 177 | 183 | 46 |
| Kyanamukaka .. | 241 | 226 | 215 | 201 | .. |
| Six Centres .. | 277 | 258 | 256 | 273 | 19 |

*Lint Length (mm.).*

|                  |      |      |      |      |                    |
|------------------|------|------|------|------|--------------------|
| Bukalasa ..      | 25.8 | 30.3 | 28.2 | 29.4 | Bulk samples only. |
| Kalagala ..      | 27.3 | 29.9 | 28.8 | 28.2 |                    |
| Mukono ..        | 26.5 | 30.3 | 27.9 | 29.8 |                    |
| Bukomero ..      | 25.9 | 30.5 | 29.4 | 30.1 |                    |
| Kabasanda ..     | 25.8 | 29.4 | 26.9 | 29.6 |                    |
| Nkozi ..         | 27.4 | 31.7 | 29.1 | 29.9 |                    |
| Kalungu ..       | 26.8 | 30.0 | 29.1 | 28.5 |                    |
| Kyanamukaka ..   | 26.2 | 29.9 | 27.9 | 29.9 |                    |
| Eight Centres .. | 26.5 | 30.3 | 28.4 | 29.4 |                    |

Yields were generally the same as last year, the noteworthy differences being at Kyanamukaka and Kalungu where lower yields were obtained. B.P.52 did not come out quite so well as in the previous year owing to its greater susceptibility to Black Arm, but its quality was in every case a considerable advance on Local. The mixture "X" did well. B.P.104, although yielding well, did not produce very good lint, its ginning outturn was low and it had the unsatisfactory character of late maturity.

The remarkably low rainfall at Kalungu shows that cotton can stand considerable periods of drought and still produce a fairly reasonable crop. The trial here was planted on 24th June and the rainfall figures show the unusually dry spell experienced by the crop during its normal growing period.

**Increase.**

B.P.52 was grown in a 16-acre increase plot and also on the main experimental area on the plantation, on the Model Shamba and on one of the Model Smallholdings. Yields varied considerably according to

planting date and soil conditions.  $3\frac{1}{2}$  acres on the plantation averaged over 1,000 lbs. per acre for May and June sowings, and 3 acres on the Smallholding gave over 1,000 lbs. per acre. The main increase block of 16 acres yielded at the rate of 475 lbs. per acre which was disappointing, although the very bad patches of soil in this area were sufficient to account for a considerable reduction in yield. Black Arm was definitely severe on all early sown B.P.52 but despite this yields of over 1,000 lbs. per acre were obtained. Ginning percentage on 7,000 lbs. commercially ginned was over 31%.

The quality of B.P.52 was maintained, but in common with all other cottons the later pickings were shorter in staple and rougher than normal owing to intense drought conditions.

B.P.52 will be grown on the Kawanda Seed Farm and Segregated Area in the 1938/39 season which will provide its first real field test.

Behaviour in the variety trials has been varied, in some B.P.52 has done better than Local, in others the reverse has occurred. It appears fairly certain that on good soils B.P.52 is as good or better yielding than Local, whereas on poor soils Local gives the better yield, probably owing to its very heterogenous state.

*B.P.104.*—A derivative from S.G.23/8, B.P.104 was grown in a  $1\frac{1}{2}$ -acre plot at Bukalasa. It has good lint and appears resistant to Black Arm, and fairly resistant to Wilt. Unfortunately it matures late—a great disadvantage in Buganda where so much of the cotton is late sown. The yield was at the rate of 847 lbs. seed cotton per acre.

*B.P.116, Bulk V.*—This strain originated from B.P.52 and was bulked from a pedigree of the previous season from plants entirely free from Black Arm. Unfortunately no sign of resistance was shown but a quarter-acre plot on very poor soil gave a fairly satisfactory yield of 587 lbs. seed cotton per acre.

*Mass Selection No. 1.*—A quarter-acre plot of Mass selected Local was grown at Kawanda and yielded at the rate of 250 lbs. per acre. Very poor growth was made, and it was obvious that the soil was too compacted after years under rubber for satisfactory results to be obtained so soon after clearing.

*Smaller Increase Plots.*—Small plots of B.274 (Local selection), B.P.79, B.P.103 (B.P.50 origin), B.181 and Coker Wilds Strain 7 were grown to provide sufficient seed for trials if required. B.274 was abandoned as being too susceptible to Black Arm and too low yielding.

### Spinning Tests and Brokers' Reports (1936-37 Crop).

The Empire Cotton Growing Corporation, The Shirley Institute, The Indian Central Cotton Committee and Messrs. Wolstenholme and Holland have again very kindly arranged for reports and spinning tests to be made on samples of lint from Uganda.

Brokers' reports on B.P.52 were very satisfactory, Messrs. Wolstenholme and Holland reported on a sample grown at Bukalasa that it was the best Uganda cotton they had ever seen, valuing it at 7.25d. per lb.

compared with Local (Buganda) at 6.15d. when American Middling was 4.90d.

In the spinning tests the reports from the Shirley Institute show that B.P.52 was longer and considerably stronger than Local, but Local on the whole gave yarns of slightly better appearance.

U.B.24/4 was the poorest sample both as regards yarn strength and yarn appearance. The varieties B.P.104 and X (a mixture of S.G.23/8, B.P.52 and B.P.79) gave as strong yarns as B.P.52. The following tables summarise the results:—

#### *Hair Characters.*

| Variety<br>and Place of<br>Growth. | Length              |                                      | % Normal<br>Hairs. | % Dead<br>Hairs. | Hair wt. <sup>.5</sup><br>per cm.(10<br>mgm). |
|------------------------------------|---------------------|--------------------------------------|--------------------|------------------|-----------------------------------------------|
|                                    | Mean<br>32nds inch. | Effective<br>Length<br>(32nds inch). |                    |                  |                                               |
| <b>Bukalasa.</b>                   |                     |                                      |                    |                  |                                               |
| Local ..                           | 29                  | 39                                   | 48                 | 16               | 163                                           |
| B.P.52 ..                          | 31                  | 44                                   | 50                 | 21               | 137                                           |
| X ..                               | 30                  | 43                                   | 52                 | 17               | 141                                           |
| B.P.104 ..                         | 31                  | 42                                   | 54                 | 15               | 150                                           |

#### *Spinning Tests.*

| Variety<br>and Place of<br>Growth. | Count × Strength. |              |              | Highest<br>Standard<br>Count. |
|------------------------------------|-------------------|--------------|--------------|-------------------------------|
|                                    | 50's counts.      | 64's counts. | 80's counts. |                               |
| <b>Bukalasa.</b>                   |                   |              |              |                               |
| Local ..                           | 1,934             | 1,715        | ..           | 46                            |
| B.P.52 ..                          | ..                | 2,050        | 1,819        | 67                            |
| X ..                               | ..                | 2,083        | 1,779        | 68                            |
| B.P.104 ..                         | ..                | 2,040        | 1,783        | 67                            |
| <b>Mukono.</b>                     |                   |              |              |                               |
| Local ..                           | 1,961             | 1,864        | ..           | 46                            |
| B.P.52 ..                          | ..                | 2,096        | 1,866        | 71                            |
| <b>Kalagala.</b>                   |                   |              |              |                               |
| Local ..                           | 1,920             | 1,735        | 1,463        | 46                            |
| B.P.52 ..                          | ..                | 2,113        | 1,931        | 74                            |
| <b>Kyanamukaka.</b>                |                   |              |              |                               |
| Local ..                           | 1,961             | 1,770        | 1,520        | 48                            |
| B.P.52 ..                          | ..                | 2,051        | 1,802        | 67                            |
| <b>Kalungu.</b>                    |                   |              |              |                               |
| Local ..                           | 1,975             | 1,773        | ..           | 48                            |
| B.P.52 ..                          | ..                | 2,048        | 1,817        | 67                            |

There is no doubt that B.P.52 shows a considerable advance over Local in quality. As improved quality is the first essential in the Western Area B.P.52 will be increased as rapidly as possible, for although its agricultural characters are on the whole not so good as those of Local, yet it has never failed completely at any testing centre, and it often yields better than Local. It has the additional advantage of being quicker maturing than Local. The character which gives cause for anxiety is Black Arm susceptibility which, however, is not so limiting a factor in the Western Area as in the Eastern where harder conditions necessitate a high degree of resistance. The present state of Buganda lint is such

as to necessitate its replacement with a variety giving really good lint as soon as possible.

### *Examination of Samples.*

Samples were collected from various parts of the Western Area during the crop estimation. A summary of the results of the examination of these samples is tabulated below:—

| Origin.             | Lint Length<br>(mm.). | Ginning percentage<br>(12-inch gin). | Lint Index. |
|---------------------|-----------------------|--------------------------------------|-------------|
| MENGO DISTRICT—     |                       |                                      |             |
| Bulemezi .. ..      | 27.4                  | 30.0                                 | 5.7         |
| Kyadondo .. ..      | 26.6                  | 31.7                                 | 5.5         |
| Kyagwe .. ..        | 26.8                  | ..                                   | ..          |
| Singo .. ..         | 26.3                  | 33.2                                 | 5.8         |
| Gomba .. ..         | 27.2                  | 30.9                                 | 5.2         |
| Busiro .. ..        | 27.3                  | 31.9                                 | 5.4         |
| Butambala .. ..     | 27.4                  | 33.2                                 | 5.6         |
| Mawokota .. ..      | 27.3                  | 33.1                                 | 5.6         |
| MASAKA DISTRICT ..  | 27.2                  | 32.8                                 | 5.5         |
| MUBENDE DISTRICT .. | 26.9                  | 32.3                                 | 5.6         |
| BUNYORO DISTRICT .. | 29.2                  | 33.5                                 | 6.2         |

These samples represent the earliest portion of the crop. Later samples were even shorter stapled, the loss of length being due to the extremely dry conditions during development. The longer length of Bunyoro cotton is due to the fact that S.G.29 is in general cultivation in that district.

### **Cotton Conference.**

A Cotton Conference was held in Uganda in November, and was attended by representatives from the Sudan, Kenya, Tanganyika, Northern and Southern Rhodesia, Nyasaland and South Africa.

Visits were made to Bukalasa and Serere, and most interesting and useful discussions took place on the actual plots at both centres.

The Conference met in Kampala for round table discussions, particular attention being paid to the damage by pests and diseases. A separate report has been submitted.

### **Insect Pests.**

At no time were pests really serious except on the early sown part of the Main Increase Plot (B.P.52); here *Lygus* and *Helopeltis* were severe for a time, but fortunately they did not spread to other parts of the plot and the severity of attack passed off as soon as good rains occurred.

Stainers were never serious until right at the end of the season, too late to have any effect on the crop.

### **Diseases.**

#### *(a) Black Arm.*

There was more Black Arm this season than in any season since 1929. Early sown cotton was quite severely attacked but as so often happens with early sowings, the attack was thrown off and new growth was made in time to produce a good crop. B.P.52 was more susceptible



than Local and follows all Nyasaland Uplands in this respect. The most resistant varieties were B.181, S.P.84 and S.P.102, of which B.181 and S.P.84 have short and rather rough lint.

(b) *Wilt.*

A full programme of work on Wilt resistance was carried out. The section of the 1936/37 Breeding Plot which was so heavily infected with Wilt was used for testing all new varieties.

Plenty of Wilt occurred in the plot and no evidence of high resistance in any variety was obtained. Variation in degrees of susceptibility occurred, B.P.79 (B.P.50 origin) and Coker Wilds Strain 7 (from U.S.A.) being the most susceptible. As in the variety trial, so in this plot, many plants showed no external symptoms of the disease and only when the tissues were examined were typical Wilt symptoms observed. This may indicate tolerance of the disease.

The following table gives the results from this plot:—

| Variety.                               | Percentage Plants showing External Symptoms. | Percentage Plants showing External and/or Internal Symptoms. |
|----------------------------------------|----------------------------------------------|--------------------------------------------------------------|
| B.P.52 .. ..                           | 19                                           | 50                                                           |
| B.P.52 (Wilt free 1936/37) .. ..       | 28                                           | 79                                                           |
| S.G.23/8 (Wilt free 1936/37) .. ..     | 22                                           | 53                                                           |
| B.P.50 (Wilt free 1936/37) .. ..       | 50                                           | 63                                                           |
| B.P.79 .. ..                           | 65                                           | 95                                                           |
| B.181 .. ..                            | 17                                           | 60                                                           |
| Dixie Triumph (U.S.A.) .. ..           | 33                                           | 69                                                           |
| Coker Clewewilt, Str. 5 (U.S.A.) .. .. | 22                                           | 67                                                           |
| Tidiwatu No. 29 (U.S.A.) .. ..         | 49                                           | 78                                                           |
| Coker Wilds Str. 7 (U.S.A.) .. ..      | 51                                           | 81                                                           |
| Rhym Cook (U.S.A.) .. ..               | 33                                           | 74                                                           |
| Dixie 14-5 Str. 2 .. ..                | 51                                           | 78                                                           |
| Local .. ..                            | 11                                           | 38                                                           |

The strains from the United States of America were imported in 1936/37 as they were resistant to Wilt under American conditions. It is obvious that they are not resistant under Uganda conditions, and further, they are practically all glabrous and Jassid susceptible, and very short linted. Dixie Triumph had a mean lint length of only 22.5 mm., Dixie 14-5, Strain 2 of 24.6 mm., Tidiwatu 27.8 mm., and Coker Wilds Strain 7 27.9 mm.

If absence of external symptoms means tolerance of the disease, then Local, B.181, B.P.52, S.G.23/8 and Coker Clewewilt Strain 5 are clearly tolerant.

Another plot with very highly infected soil gave proof of the difficulty of ensuring infection. In addition to the previous infection of the soil, every hole was supplied with Wilt culture material obtained from the Plant Pathologist, in an endeavour to make certain that every plant had an equal chance of infection. The amount of Wilt occurring on the plot was less than ever before recorded. The same varieties as above were planted. As an example—B.P.52 (Wilt free 1936/37) only had 16% plants showing external and internal symptoms, Tidiwatu, only 9%,

and Coker Wilds Strain 7, only 15%. Testing for Wilt resistance is thus complicated by the absence of any certainty that all plants have an equal chance of infection and by the fact that plants may have the disease without showing any external symptoms.

Recovery from the disease was again observed in several strains.

Samples of lint from infected and healthy plants of the same strain were submitted to the Shirley Institute for hair tests with the following results:—

|                               | Wilted Plants.       | Wilt free Plants.    |
|-------------------------------|----------------------|----------------------|
| Maximum length .. ..          | 55/32nds of an inch. | 54/32nds of an inch. |
| Effective length .. ..        | 44/32nds of an inch. | 45/32nds of an inch. |
| % Disperser .. ..             | 25                   | 22                   |
| % Short Fibre .. ..           | 31                   | 24                   |
| Hair weight per centimetre .. | 158 gr.              | 153 gr.              |
| Immaturity—                   |                      |                      |
| % normal .. ..                | 41                   | 46                   |
| % dead .. ..                  | 23                   | 21                   |

There appears to be rather more short fibre in the lint from wilted plants and the percentage of normal hairs is slightly less. It is doubtful if these differences are significant and further confirmatory tests will be required.

### Soy Beans.

The importance of Soy beans from a nutritional standpoint needs no emphasis. Excellent crops have been obtained at Bukalasa in both seasons. *i.e.*, early and late rains and there is every reason to expect higher yields as seed becomes acclimatized and soils become infected with the nodule forming organism. Actually, nodule formation has only occurred on one very small plot at Bukalasa. Numerous varieties have been obtained from America and South Africa, and these are being increased for proper yield trials. Considerable variation in earliness, straw production, etc., was observed.

A variety trial of Serere seed, Barberton Y 1 and Laredo gave the following results:—

|                              |                      |
|------------------------------|----------------------|
| Barberton Y 1 .. ..          | 1,060 lbs. per acre. |
| Serere .. ..                 | 840 lbs. per acre.   |
| Laredo .. ..                 | 215 lbs. per acre.   |
| Least Significant Difference | 258.                 |

Barberton Y 1 was definitely earlier maturing than Serere. The Serere variety selected by Mr. Hosking in Trinidad appears to be very suitable for forage owing to the large amount of vegetable material produced.

Quarter-acre increase plots sown in the late rains gave yields at the rate of 664 lbs. per acre for Local and 626 for Barberton Y 1, which were very satisfactory. Very little disease occurred, although at that time of the year *Cercospora* is usually very severe on all types of beans.

### Groundnuts.

A variety trial consisting of Bukalasa Bunch, Masaka Bunch and Mbarara Bunch showed no differences whatsoever between the three. The yields (unshelled) per acre were as follows:—

|            |    |            |
|------------|----|------------|
| Bukalasa.. | .. | 2,059 lbs. |
| Mbarara .. | .. | 2,056 lbs. |
| Masaka ..  | .. | 1,950 lbs. |

Increase plots of Serere varieties, A.K.10 (from India) and a few Local selections, were grown to provide seed for proper trials. A plot of A.K.10 gave 1,320 lbs. per acre of very large nuts.

### Sesame (Simsim).

Rogueing plots were grown, of the Main Kiganda varieties—Luzige, Nalongo, Nandigobe, Zoya and Bwonyo (a Lango variety). The best yielding of these was Nandigobe with 803 lbs. per acre followed by Zoya—a very hirsute variety with 768 lbs. per acre. Bwonyo was the lowest yielder with 330 lbs. per acre.

Single plant selections from the 1936/37 season yielded well, in particular S.S.28/36 and S.S.30/36.

The types with eight-locked capsules (Nalongo — Twins) are liable to fasciation in other parts of the plant, particularly in the flowering spike where it causes considerable reduction in yield.

Numerous new selections were made in the field.

### Cassava.

The collection of varieties was augmented by further types from Amani and by new types found in Buganda.

The promising Mosaic resistant variety—Nakasoga (Nodewide) gave very poor yields in a variety trial, and in fact gave a significantly lower yield than the highly Mosaic susceptible varieties Greyhound and Nakachachali. The most promising variety appears to be Nakasoga, a tall erect type with practically sessile leaves. This variety does well under bad conditions, *e.g.*, Buruli and Bugerere Counties, and should prove a valuable famine reserve. It remains in good condition in the soil for at least three years and is considered palatable. It yielded at a higher rate than any of the other varieties in the trial:—

| Variety.     |    |    |    | Yield per Acre. | Resistance to Mosaic. |
|--------------|----|----|----|-----------------|-----------------------|
| Nakasoga     | .. | .. | .. | 8,850           | Resistant.            |
| Greyhound    | .. | .. | .. | 7,560           | Very susceptible.     |
| Nakachachali | .. | .. | .. | 6,860           | Very susceptible.     |
| Nodewide     | .. | .. | .. | 3,820           | Very resistant.       |

A variety trial of three quick maturing varieties—Bintiminsi, Amani and Machunde gave the following results:—

*Yields: Tons Fresh Tubers per Acre.*

|            |    | Flat Cultivation. | Ridge Cultivation. |      |
|------------|----|-------------------|--------------------|------|
| Bintiminsi | .. | 6.19              | 6.25               | 6.22 |
| Machunde   | .. | 5.05              | 5.43               | 5.24 |
| Amani      | .. | 5.02              | 5.96               | 5.49 |
|            |    | 5.42              | 5.88               | 5.65 |

These three varieties are considered to be very palatable, but they are of no use for famine reserve as they mature in 9 months and are too old after 14 months.

No spread of Wilt and Black Arm was observed during the season.

### Other Crops.

Collections of Yams, Tannias, Sweet Potatoes, Peas, Soy Beans and Bambarra Groundnuts are being made with a view to selecting the best types for supplementing the native diet. Several new varieties of these crops have been obtained from other countries.

G. W. NYE,  
*Senior Botanist.*

## (ii) REPORT OF THE BOTANIST, SERERE.

### Meteorological Conditions 1937/38.

The "dry season" of 1937 was rather wetter than usual, but this was followed immediately by a comparatively dry April. May was wet and conditions were generally ideal for early cotton planting. June was dry, and there was another lull in September, but on the whole the rainfall during the planting and growing seasons was much above the average. This resulted in large woody plants, and also caused the optimum sowing date to shift down to mid June, because the cotton planted prior to this received too much moisture and expended its energies in developing wood rather than bolls. Despite the vagaries of the climate and the high incidence of Jassid, yields were again above average, although at one time it could not have been foreseen that the season was going to turn out so well.

The shortage of rain in September coming in a long period of high precipitation caused considerable variation in lint length and staple character.

### Diseases and Pests.

Owing to rather wet conditions during the growing months and to a few slight hail storms, Black Arm disease was rather more serious at Serere than in the previous seasons.



Jassids were found in larger numbers than have been recorded at Serere before. The susceptible strains showed marked symptoms of Jassid damage, and for the first time it was found possible to correlate low yield with high Jassid population on a statistical basis.

The grade of the crop was well below average as it contained a considerable amount of *Nematospora* stain.

### The Cotton Breeding Plot.

#### (1) *Pedigree Lines.*

The breeding plot was planted on July 5th. Fair stands were obtained. It was very soon obvious that the soil of the plot was very poor. Growth was slow throughout, and plant yields were only about the same as the previous season, despite generally higher yields on the rest of the farm. The plants were damaged by hail on three occasions, and thus a higher attack of Black Arm than usual resulted owing to the disease entering the hail bruises. Many plants were topped, and it was difficult to judge habit of growth. Serere Crosses and Back Crosses were by far the most vigorous group in the breeding plot.

#### *Biological Characters.*

| Strain.    | Origin.                          | Parent.    | Black Arm Lesions per Plant. | Jassid nymphs per Plant. | Hairiness Index*. |
|------------|----------------------------------|------------|------------------------------|--------------------------|-------------------|
| S.P.140 .. | { S.P.87 from U.4.4.2            | S.P.122    | 3.3                          | 1.5                      | 3.1               |
| S.P.144 .. |                                  | S.P.134    | 2.5                          | 1.1                      | 4.5               |
| S.P.146 .. |                                  | S.P.136    | 3.1                          | 1.0                      | 3.8               |
| S.P.147 .. | { S.P.102 from S.G.29 hybrid.    | S.P.137    | 0.8                          | 0.8                      | 4.1               |
| S.P.148 .. |                                  | S.P.138    | 0.6                          | 1.1                      | 4.2               |
| S.P.149 .. |                                  | S.P.138    | 0.5                          | 1.2                      | 4.1               |
| S.P.151 .. | Nariama N.17.                    | S.P.93     | 2.1                          | 1.5                      | 2.0               |
| B.P.50.S.6 | Reselection from Bukalasa B.P.50 | B.P.50.S.2 | 1.7                          | 1.2                      | 4.0               |

\* Hairiness Index. Each plant marked 0-5, 0 being glabrous, 5 very hairy.

#### *Biological Characters.*

| Strain.        | Habit.                                                     |
|----------------|------------------------------------------------------------|
| S.P.140 ..     | Rather woody, and taller than usual U.4. Fairly early.     |
| S.P.144 ..     |                                                            |
| S.P.146 ..     |                                                            |
| S.P.147 ..     | Small compact cluster type. Early. Quick cropper.          |
| S.P.148 ..     |                                                            |
| S.P.149 ..     |                                                            |
| S.P.151 ..     | Leafy, rather glabrous and woody. Rather monopodial. Late. |
| B.P.50.S.6     | Upright, hairy, sympodial. Early.                          |
| Control S.G.29 | Tall, monopodial, woody, fairly hairy. Late.               |

*Boll Characters.*

| Strain.       | Effective<br>Flowers<br>per Plant. | Seed Cotton<br>per Plant<br>gms. | Seed Cotton<br>per Flower*<br>gms. | Ginning<br>Percentage. | Lint Length<br>mm. |
|---------------|------------------------------------|----------------------------------|------------------------------------|------------------------|--------------------|
| S.P.140 .. .. | 35.5                               | 43                               | 1.21                               | 37.14                  | 30.36              |
| S.P.144 .. .. | 43.8                               | 49                               | 1.12                               | 33.60                  | 29.45              |
| S.P.146 .. .. | 41.5                               | 53                               | 1.28                               | 34.15                  | 31.30              |
| S.P.147 .. .. | 30.3                               | 42                               | 1.39                               | 34.23                  | 31.10              |
| S.P.148 .. .. | 32.7                               | 42                               | 1.28                               | 33.88                  | 29.70              |
| S.P.149 .. .. | 31.4                               | 43                               | 1.37                               | 33.21                  | 31.40              |
| S.P.151 .. .. | 41.2                               | 54                               | 1.31                               | 31.75                  | 29.25              |
| B.P.50.S.6 .. | 35.3                               | 44                               | 1.25                               | 33.11                  | 32.10              |

\* See Annual Report, 1937, Part II.

S.P.147 clearly shows the lowest shedding percentage, since with the lowest number of effective flowers per plant, it has the highest weight of seed cotton per flower. This strain also showed marked resistance to both Black Arm and Jassid attack. S.P.144 was undoubtedly the best of the S.P.87 derivatives; this group was unlucky in that they were planted in the poorest soil in the breeding plot.

(2) *Serere Hybrids.*

The programme included reference rows of the parental types; F1, F2, and F3 generations of simple crosses; and F1 and F2 generations of back-crosses.

From the point of view of yield only, the following were the best back-crosses:—

- (i) (N.17 × S.P.13) × S.P.13.
- (ii) (N.17 × S.P.80) × S.P.80.
- (iii) (S.G.29 × S.P.80) × S.G.29.
- (iv) (S.P.80 × S.G.23.8) × S.P.80.
- (v) (B.P.50 × S.P.80) × B.P.50.

The following crosses and back-crosses have high resistance to Jassids coupled with high resistance to Black Arm disease:—

- F1. (N.17 × B.P.50) and (S.G.23.8 × B.P.50).
- F2. (S.P.80 × B.P.50).
- F3. (S.P.80 × S.G.29).

Back-crosses:—

- (N.17 × S.P.80) × S.P.80.
- (S.P.80 × B.P.50) × S.P.80.
- (S.P.80 × B.P.50) × B.P.50.
- (S.P.13 × S.G.29) × S.P.13.
- (S.P.80 × S.G.29) × S.P.80.

It will be seen that certain back-crosses have given high yields as well as good resistance to Jassids and Black Arm disease, notably the following:—

(N.17 × S.P.80) × S.P.80.

(B.P.50 × S.P.80) × B.P.50.

Certain individual plants in these two groups have produced very nice lint. If these types can be fixed a big advance will have been made.

It is intended to concentrate future work on the following groups:—

(i) N.17 and S.P.13.

(ii) N.17 and S.P.80.

(iii) S.P.80 and B.P.50.

The following tables summarise the characters of the more promising crosses.

| Cross ♂ × ♀                   | Generation | Black Arm Lesions per Plant. | % Plants free from Black Arm | Jassid Nymphs per Plant. | Hairiness Index. |
|-------------------------------|------------|------------------------------|------------------------------|--------------------------|------------------|
| S.P.80 × S.G.29 .. ..         | F3         | 0.72                         | 64                           | 1.5                      | 1.8              |
| S.P.80 × B.P.50 .. ..         | F2         | 0.68                         | 52                           | 1.4                      | 1.0              |
| N.17 × B.P.50 .. ..           | F1         | 0.96                         | 50                           | 1.3                      | 1.9              |
| S.G.29 × (S.P.80 × S.G.29) .. | F2         | 0.78                         | 52                           | 1.1                      | 1.7              |
| (S.P.13 × S.G.29) × S.P.13 .. | F2         | 0.58                         | 58                           | 1.5                      | 1.5              |
| S.P.13 × (N.17 × S.P.13) ..   | F1         | 0.64                         | 60                           | 1.5                      | 2.2              |
| (N.17 × S.P.13) × S.P.13 ..   | F1         | 0.43                         | 71                           | 1.7                      | 1.6              |
| (N.17 × S.P.80) × S.P.80 ..   | F1         | 0.73                         | 55                           | 1.4                      | 2.1              |
| (S.P.80 × B.P.50) × S.P.80 .. | F1         | 1.32                         | 52                           | 1.4                      | 1.8              |
| (S.P.80 × B.P.50) × B.P.50 .. | F1         | 0.70                         | 65                           | 1.3                      | 2.4              |

| Cross ♂ × ♀                   | Wt. of Seed Cotton per Plant. gms. | Wt. of Lint per Plant. gms. | G.O.T. % | Mean Lint Length mm. |
|-------------------------------|------------------------------------|-----------------------------|----------|----------------------|
| S.P.80 × S.G.29 .. ..         | 46.56                              | 24.36                       | 33.58    | 29.46                |
| S.P.80 × B.P.50 .. ..         | 42.24                              | 19.45                       | 34.43    | 29.62                |
| N.17 × B.P.50 .. ..           | 54.08                              | 20.46                       | 31.60    | 30.20                |
| S.G.29 × (S.P.80 × S.G.29) .. | 52.04                              | 22.21                       | 35.14    | 29.00                |
| (S.P.13 × S.G.29) × S.P.13 .. | 40.50                              | 21.66                       | 34.36    | 28.00                |
| S.P.13 × (N.17 × S.P.13) ..   | 67.28                              | 29.18                       | 31.84    | 27.75                |
| (N.17 × S.P.80) × S.P.13 ..   | 86.00                              | 33.57                       | 36.71    | 28.90                |
| (N.17 × S.P.80) × S.P.80 ..   | 70.10                              | 27.17                       | 34.70    | 29.74                |
| (S.P.80 × B.P.50) × S.P.80 .. | 47.56                              | 25.10                       | 36.03    | 28.91                |
| (S.P.80 × B.P.50) × B.P.50 .. | 68.00                              | 24.81                       | 33.88    | 30.02                |

NOTE.—The yield of seed cotton in the above table is the mean of all plants in the row. The remaining three factors are derived only from plants yielding more than 50 gms. of seed cotton. Consequently the ginning percentages are not comparable with the corresponding weights of seed cotton and lint.

### (3) *New Selections.*

These consisted of 60 selections from Nyasaland Uplands, two reselections from a mixed Cambodia population, and 30 reselections from U.4.4.2.

In addition, six so-called commercially Wilt-resistant varieties from the U.S.A. were grown. These, with the exception of one plant, were

a very fine demonstration of acute Jassid susceptibility owing to their glabrous leaves.

Of 15 reselections from Busoga N.17 numbered N.17/1 to N.17/15; N.17/5, N.17/8 and N.17/15 were outstanding for Black Arm resistance, while N.17/3, N.17/5, N.17/7 and N.17/8 were very hairy and resistant to Jassids. N.17/5 was one of the hairiest rows growing in the breeding plot.

### Miniature Variety Trial, Serere.

The trial contained seven "varieties" replicated in six randomised blocks. Each plot consisted of three rows of 50 plants each at 3 feet by 1 foot spacing. Only the centre row of each plot was utilised for yield or insect population comparisons.

This trial was utilised to determine whether the various seed types of Busoga N.17 yield differently and react differently to insect pests. S.G.29 and S.P.88 were also included; the former being fairly resistant to Jassid and susceptible to Black Arm, the latter *per contra* being susceptible to Jassid and resistant to Black Arm. Four seed types of Busoga N.17 were tested, *i.e.*, heavy white fuzz, normal white fuzz, very sparse white fuzz and naked seed.

The following table summarises the results obtained:—

| "Variety."                   |    |    |    | Yield lbs. Seed<br>Cotton. | Vegetative<br>Efficiency. | Total<br>Black-Arm<br>Lesions per<br>Plant. | Black-Arm<br>Intensity. | No. of Jassid<br>nymphs on<br>50 Leaves. | Ginning %. |
|------------------------------|----|----|----|----------------------------|---------------------------|---------------------------------------------|-------------------------|------------------------------------------|------------|
| S.G.29                       | .. | .. | .. | 1.91                       | 0.139                     | 1.20                                        | 3.4                     | 30.7                                     | 33.3       |
| S.P.88                       | .. | .. | .. | 2.20                       | 0.135                     | 0.29                                        | 0.8                     | 47.2                                     | 34.3       |
| Mixed N.17                   | .. | .. | .. | 2.30                       | 0.092                     | 0.85                                        | 1.3                     | 57.6                                     | 31.1       |
| N.17 Heavy fuzz              | .. | .. | .. | 2.32                       | 0.102                     | 0.97                                        | 1.2                     | 54.8                                     | 30.4       |
| N.17 Normal fuzz             | .. | .. | .. | 2.09                       | 0.129                     | 0.87                                        | 2.3                     | 50.4                                     | 31.4       |
| N.17 Sparse fuzz             | .. | .. | .. | 2.26                       | 0.100                     | 1.04                                        | 1.5                     | 56.5                                     | 29.8       |
| N.17 Naked seed              | .. | .. | .. | 2.29                       | 0.093                     | 1.03                                        | 1.3                     | 61.3                                     | 32.1       |
| Least Significant Difference |    |    |    | .. none                    | none                      | 0.34                                        | 1.3                     | 11.3                                     | none       |

No significant differences could be demonstrated in the comparisons of yield, vegetative efficiency and ginning percentage.

Using the Black Arm intensity figures it can be seen that there are indications that N.17 Normal White fuzz is more susceptible to this disease than the other three seed types of N.17.

Naked seed appears to be associated with glabrous plants, since Naked and Sparse fuzz are on the whole more susceptible to Jassids than Heavy and Normal fuzz seed types. A surprising result is the comparatively high ginning percentage of Naked seed, these particular figures are, however, not very reliable.

It will be seen that the Jassid susceptible Nariama derivative, S.P.88 is less susceptible to Jassids than Naked seeded N.17.



### Combined Variety, Spacing and Sowing Date Trial, Serere.

The experiment was laid out on Block A of the Experiment Farm in the same type of layout used in previous seasons.

The treatments were:—

|                 |                                     |
|-----------------|-------------------------------------|
| Sowing Dates .. | Mid April.                          |
|                 | Mid May.                            |
|                 | Mid June.                           |
|                 | Mid July.                           |
| Spacings ..     | 3' × ½'.                            |
|                 | 3' × 1'.                            |
|                 | 3' × 1½'.                           |
| Varieties ..    | S.G.29 (Control).                   |
|                 | S.P.20 ( <i>ex</i> U.4.4.2).        |
|                 | S.P.84 ( <i>ex</i> U.4.4.2).        |
|                 | S.P.90 ( <i>ex</i> U.4.4.2).        |
|                 | S.P.92 ( <i>ex</i> U.4.4.2).        |
|                 | S.P.102 ( <i>ex</i> S.G.29 hybrid). |

#### (1) Field Results.

The following tables demonstrate the results after converting actual yields to yields per acre.

#### *Varieties (Irrespective of Spacing or Sowing Date).*

| Varieties.                         |    |    |    |    | Total Cotton<br>lbs. per acre. | First Quality<br>Lint<br>lbs. per acre. | Ginning<br>Percentage. |
|------------------------------------|----|----|----|----|--------------------------------|-----------------------------------------|------------------------|
| S.G.29                             | .. | .. | .. | .. | 660.3                          | 128.9                                   | 32.9                   |
| S.P.20                             | .. | .. | .. | .. | 1,014.3                        | 239.5                                   | 37.8                   |
| S.P.84                             | .. | .. | .. | .. | 941.5                          | 217.9                                   | 36.6                   |
| S.P.90                             | .. | .. | .. | .. | 787.6                          | 183.4                                   | 35.5                   |
| S.P.92                             | .. | .. | .. | .. | 793.1                          | 182.9                                   | 39.2                   |
| S.P.102                            | .. | .. | .. | .. | 938.7                          | 198.4                                   | 33.6                   |
| Least Significant Difference .. .. |    |    |    |    | 42.2                           | 12.2                                    | 0.2                    |

#### *Sowing Dates (Irrespective of Varieties or Spacings).*

|                                    |    |    |    |    | Total Cotton<br>lbs. per acre | First Quality<br>Lint<br>lbs. per acre. | Ginning<br>Percentage. |
|------------------------------------|----|----|----|----|-------------------------------|-----------------------------------------|------------------------|
| Mid April                          | .. | .. | .. | .. | 794.8                         | 165.6                                   | 36.2                   |
| Mid May                            | .. | .. | .. | .. | 868.1                         | 191.2                                   | 36.2                   |
| Mid June                           | .. | .. | .. | .. | 997.1                         | 223.4                                   | 36.2                   |
| Mid July                           | .. | .. | .. | .. | 812.0                         | 186.4                                   | 35.1                   |
| Least Significant Difference .. .. |    |    |    |    | none                          | none                                    | 0.3                    |

#### *Spacings (Irrespective of Varieties or Sowing Dates).*

| Spacing.                           |    |    |    |    | Total Cotton<br>lbs. per acre. | First Quality<br>Lint<br>lbs. per acre. | Ginning<br>Percentage. |
|------------------------------------|----|----|----|----|--------------------------------|-----------------------------------------|------------------------|
| 3' × ½'                            | .. | .. | .. | .. | 817.6                          | 176.7                                   | 36.0                   |
| 3' × 1'                            | .. | .. | .. | .. | 1,187.7                        | 201.8                                   | 36.0                   |
| 3' × 1½'                           | .. | .. | .. | .. | 1,146.0                        | 196.7                                   | 35.9                   |
| Least Significant Difference .. .. |    |    |    |    | 43.4                           | 11.7                                    | none                   |

*Interaction of Variety  $\times$  Sowing Date. First Quality Lint lbs. per Acre.*

|               | Mid April. | Mid May. | Mid June. | Mid July. | Least Significant Differences<br>lbs. per acre. |
|---------------|------------|----------|-----------|-----------|-------------------------------------------------|
| S.G.29 .. ..  | 109.3      | 126.4    | 149.1     | 130.1     |                                                 |
| S.P.20 .. ..  | 220.9      | 238.5    | 265.9     | 232.0     |                                                 |
| S.P.84 .. ..  | 182.0      | 220.5    | 244.1     | 225.1     | 24.5 between any                                |
| S.P.90 .. ..  | 140.3      | 193.1    | 239.0     | 161.6     | entry.                                          |
| S.P.92 .. ..  | 162.6      | 186.7    | 220.0     | 161.6     |                                                 |
| S.P.102 .. .. | 177.4      | 183.4    | 222.3     | 210.7     |                                                 |

The whole trial averaged 855.9 lbs. of seed cotton per acre (a similar trial in the previous season averaged 717.3 lbs. per acre) and 191.8 lbs. of first quality lint per acre.

DISCUSSION OF RESULTS.

A rough outline of the salient facts determined:—

*Varieties (Irrespective of Spacings or Sowing Dates).*

| Total Cotton.                                           | First Quality Lint.                                     | Ginning Percentage.                                     |
|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|
| S.P.20 > S.P.84 = S.P.102<br>> S.P.92 = S.P.90 > S.G.29 | S.P.20 > S.P.84 > S.P.102<br>> S.P.90 = S.P.92 > S.G.29 | S.P.92 > S.P.20 > S.P.84<br>> S.P.90 > S.P.102 > S.G.29 |

*Sowing Dates (Irrespective of Varieties or Spacings).*

| Total Cotton.               | First Quality Lint.         | Ginning Percentage.                                                                  |
|-----------------------------|-----------------------------|--------------------------------------------------------------------------------------|
| No significant differences. | No significant differences. | Mid July significantly lower<br>ginning percentage than<br>the earlier sowing dates. |

The significant reduction of ginning percentage with late sowing is of interest, and was foreshadowed in last year's report.

*Spacings (Irrespective of Varieties or Sowing Dates).*

| Total Cotton.                                                                       | First Quality Lint.                                               | Ginning Percentage.         |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------|
| $3' \times 1' > 3' \times \frac{1}{2}'$<br>$3' \times 1' = 3' \times 1\frac{1}{2}'$ | $3' \times 1\frac{1}{2}' = 3' \times 1' > 3' \times \frac{1}{2}'$ | No significant differences. |

*Interaction of Variety  $\times$  Sowing Date.*

| Total Cotton.                                                                                                                                                         | First Quality Lint.                                                                                | Ginning Percentage. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------|
| S.P.90 has reacted differently<br>from the other varieties<br>because its yield in the<br>first sowing date is badly<br>depressed due to heavy<br>Jassid infestation. | S.P.102 did particularly<br>well in the last two<br>sowing dates because it<br>is a quick cropper. | No significance.    |

(2) *Vegetative Efficiency.*

As described before, vegetative efficiency is the weight of seed cotton (lbs.) produced by each pound of aerial vegetable matter. The latter is obtained by weighing the "uprooted" plants at the end of the season.

*Varieties (Irrespective of Sowing Dates and Spacings).*

| 1936/37.                             |                        | 1937/38.                             |                        |
|--------------------------------------|------------------------|--------------------------------------|------------------------|
| Variety.                             | Vegetative Efficiency. | Variety.                             | Vegetative Efficiency. |
| S.G.29 (Control Nyasaland Upland) .. | 0.061                  | S.G.29 (Control Nyasaland Upland) .. | 0.128                  |
| S.P.89 (from S.G.29 hybrid) ..       | 0.070                  | S.P.102 (from S.G.29 hybrid) ..      | 0.195                  |
| S.P.20 (from U.4.4.2) ..             | 0.080                  | S.P.20 (from U.4.4.2) ..             | 0.204                  |
| S.P.84 (from U.4.4.2) ..             | 0.071                  | S.P.84 (from U.4.4.2) ..             | 0.185                  |
|                                      |                        | S.P.90 (from U.4.4.2) ..             | 0.173                  |
|                                      |                        | S.P.92 (from U.4.4.2) ..             | 0.174                  |
| Least significant difference ..      | 0.010                  | Least significant difference ..      | 0.014                  |

Yields were lower in 1936/37 than in 1937/38, the plants in the latter season were therefore more efficient. These figures clearly show the inefficiency, *i.e.*, woody habit, of S.G.29 as compared with the S.P. varieties.

*Sowing Dates (Irrespective of Varieties and Spacings).*

| 1936/37.                        |                        | 1937/38.                        |                        |
|---------------------------------|------------------------|---------------------------------|------------------------|
| Sowing Dates.                   | Vegetative Efficiency. | Sowing Dates.                   | Vegetative Efficiency. |
| Mid May .. ..                   | 0.117                  | Mid April .. ..                 | 0.118                  |
| Mid June .. ..                  | 0.138                  | Mid May .. ..                   | 0.160                  |
| Mid July .. ..                  | 0.078                  | Mid June .. ..                  | 0.248                  |
| Mid August .. ..                | 0.078                  | Mid July .. ..                  | 0.180                  |
| Least significant difference .. | 0.029                  | Least significant difference .. | 0.048                  |

In both seasons the mid June sowing date has resulted in the most efficient plants, although in 1936/37 the mid May sowings gave the highest yield, while in 1937/38 the highest yields were from the mid June plantings.

*Spacings (Irrespective of Varieties and Sowing Dates).*

| 1936/37.                        |                        | 1937/38.                        |                        |
|---------------------------------|------------------------|---------------------------------|------------------------|
| Spacings.                       | Vegetative Efficiency. | Spacings.                       | Vegetative Efficiency. |
| 3' × ½' .. ..                   | 0.092                  | 3' × ½' .. ..                   | 0.149                  |
| 3' × 1' .. ..                   | 0.106                  | 3' × 1' .. ..                   | 0.178                  |
| 3' × 1½' .. ..                  | 0.110                  | 3' × 1½' .. ..                  | 0.204                  |
| Least significant difference .. | 0.006                  | Least significant difference .. | 0.019                  |

Contrary to expectation efficiency increases as the spacing is made wider in both seasons.

(3) *Black Arm Results.*

Total lesions per plant and Black Arm intensity figures were obtained as in previous seasons. Black Arm intensity is equivalent to so many lesions per pound of plant material.

*Varieties (Irrespective of Sowing Dates or Spacings).*

| Varieties.                    |    |    |    | Mean Lesions per Plant. | Mean Black Arm Intensity. |
|-------------------------------|----|----|----|-------------------------|---------------------------|
| S.G.29                        | .. | .. | .. | 2.72                    | 8.94                      |
| S.P.20                        | .. | .. | .. | 0.86                    | 3.04                      |
| S.P.84                        | .. | .. | .. | 1.20                    | 3.76                      |
| S.P.90                        | .. | .. | .. | 1.17                    | 4.46                      |
| S.P.92                        | .. | .. | .. | 1.31                    | 4.73                      |
| S.P.102                       | .. | .. | .. | 0.59                    | 1.87                      |
| Least significant differences |    |    |    | 0.16                    | 0.59                      |

It will be noticed that the Black Arm figures are much higher than in the previous season, when S.G.29 for example averaged 1.92 and 4.88 for lesions per plant and Black Arm intensity respectively. This increase can be ascribed to hail damage.

Conclusions:—

(i) Lesions per plant—

S.G.29 >> S.P.92 = S.P.90 = S.P.84 > S.P.20 > S.P.102.

(ii) Black Arm Intensity—

S.G.29 >> S.P.92 = S.P.90 > S.P.84 > S.P.20 > S.P.102.

*Sowing Dates (Irrespective of Varieties or Spacings).*

| Sowing Date.                  |    |    |    | Mean Lesions per Plant. | Mean Black Arm Intensity. |
|-------------------------------|----|----|----|-------------------------|---------------------------|
| Mid April                     | .. | .. | .. | 1.47                    | 3.97                      |
| Mid May                       | .. | .. | .. | 1.77                    | 5.83                      |
| Mid June                      | .. | .. | .. | 1.01                    | 4.16                      |
| Mid July                      | .. | .. | .. | 0.98                    | 3.90                      |
| Least significant differences |    |    |    | 0.35                    | none                      |

Conclusions:—

(i) Lesions per plant—

April = May > June = July.

(ii) Black Arm Intensity—

No differences between sowing dates.

*Spacings (Irrespective of Varieties or Sowing Dates).*

| Spacings.                     |    |    |    | Mean Lesions per Plant. | Mean Black Arm Intensity. |
|-------------------------------|----|----|----|-------------------------|---------------------------|
| 3' × ½'                       | .. | .. | .. | 1.35                    | 6.76                      |
| 3' × 1'                       | .. | .. | .. | 1.29                    | 3.69                      |
| 3' × 1½'                      | .. | .. | .. | 1.28                    | 2.95                      |
| Least significant differences |    |    |    | none                    | 2.26                      |



Conclusions:—

(i) Lesions per plant—

No differences between spacings.

(ii) Black Arm Intensity—

$$3' \times \frac{1}{2}' > 3' \times 1' = 3' \times 1\frac{1}{2}'.$$

### District Variety Trials.

4 × 4 Latin Squares were laid down at fourteen centres in the area East of the Nile. The results expressed as yields per acre are summarised below.

#### *Yields—Lbs. Seed Cotton per Acre.*

| Centres.                   | N.17.   | S.P.20.   | S.P.84. | S.P.90.  | Least significant difference. |
|----------------------------|---------|-----------|---------|----------|-------------------------------|
| Vukula .. ..               | 1,732   | 1,571     | 1,755   | 1,574    | ..                            |
| Bugaya .. ..               | 898     | 1,119     | 1,321   | 985      | 186                           |
| Bulopa .. ..               | 975     | 1,123     | 1,203   | 1,079    | ..                            |
| Nawanzu .. ..              | 1,430   | 1,932     | 1,849   | 1,839    | 253                           |
| Busoga Means ..            | 1,259   | 1,436     | 1,532   | 1,369    | 150                           |
| Kitgum .. ..               | 1,207   | 1,471     | 1,450   | 1,433    | ..                            |
| Ngetta .. ..               | 1,057   | 1,233     | 1,150   | 1,101    | ..                            |
| Aduku .. ..                | 1,021   | 802       | 948     | 1,003    | ..                            |
| Kaberaido .. ..            | 1,434   | 1,894     | 1,935   | 1,810    | 343                           |
| Northern Province Means .. | 1,180   | 1,350     | 1,371   | 1,337    | 128                           |
|                            | S.G.29. | S.P.20.   | S.P.84. | S.P.90.  |                               |
| Katakwi .. ..              | 330     | 474       | 448     | 371      | ..                            |
| Serere .. ..               | 484     | 1,043     | 849     | 737      | 111                           |
| Bukedea .. ..              | 1,006   | 1,289     | 1,254   | 1,393    | 230                           |
| Kibale .. ..               | 1,329   | 1,775     | 1,775   | 1,694    | 228                           |
| Mulanda .. ..              | 1,661   | 1,625     | 1,807   | 1,925    | 188                           |
| "Bukedi" Means ..          | 962     | 1,241     | 1,227   | 1,224    | 67                            |
|                            | N.17.   | N.17 M.1. | B.P.52. | S.P.102. |                               |
| Vukula .. ..               | 1,733   | 1,716     | 1,794   | 2,185    | 346                           |
| Bugaya .. ..               | 983     | 1,020     | 1,173   | 1,189    | ..                            |
| Bulopa .. ..               | 711     | 664       | 581     | 982      | 345                           |
| Nawanzu .. ..              | 1,408   | 1,385     | 1,687   | 1,956    | 247                           |
| Busoga Means ..            | 1,209   | 1,196     | 1,309   | 1,578    | 155                           |

NOTE.—Nyero results spoiled.

It will be noticed that two series of trials were run in Busoga; this was done so that the Bukalasa strain B.P.52 and the mass selected population from Busoga N.17 called N.17 M.1—could be compared with ordinary Busoga N.17 and the Serere strain S.P.102.

The N.17 M.1 population was obtained by discarding all green fuzzed and naked seeds from the ordinary Busoga N.17.

*Yields—Lbs. of First Quality Cotton per Acre.*

| Centres.                      | N.17.   | S.P.20.   | S.P.84. | S.P.90.  | Least significant difference. |
|-------------------------------|---------|-----------|---------|----------|-------------------------------|
| Vukula .. ..                  | 1,530   | 1,390     | 1,586   | 1,417    | ..                            |
| Bugaya .. ..                  | 736     | 986       | 1,175   | 874      | 155                           |
| Bulopa .. ..                  | 891     | 1,030     | 1,153   | 1,033    | ..                            |
| Nawanzu .. ..                 | 1,200   | 1,778     | 1,600   | 1,669    | 319                           |
| Busoga Means ..               | 1,089   | 1,296     | 1,379   | 1,248    | 151                           |
| Kitgum .. ..                  | 911     | 1,179     | 1,006   | 1,022    | ..                            |
| Ngetta .. ..                  | 811     | 963       | 903     | 878      | ..                            |
| Aduku .. ..                   | 850     | 610       | 770     | 883      | 173                           |
| Kaberaimaido ..               | 1,220   | 1,626     | 1,650   | 1,576    | 317                           |
| Northern Province Means .. .. | 948     | 1,095     | 1,082   | 1,090    | 123                           |
|                               | S.G.29. | S.P.20.   | S.P.84. | S.P.90.  |                               |
| Katakwi .. ..                 | 190     | 270       | 247     | 202      | ..                            |
| Serere .. ..                  | 240     | 531       | 424     | 416      | 44                            |
| Bukedei .. ..                 | 796     | 1,021     | 1,018   | 1,058    | 112                           |
| Kibale .. ..                  | 1,123   | 1,555     | 1,585   | 1,508    | 183                           |
| Mulanda .. ..                 | 1,428   | 1,433     | 1,636   | 1,777    | 175                           |
| "Bukedi" Means ..             | 755     | 962       | 982     | 992      | 48                            |
|                               | N.17.   | N.17 M.1. | B.P.52. | S.P.102. |                               |
| Vukula .. ..                  | 1,482   | 1,478     | 1,552   | 1,917    | 211                           |
| Bugaya .. ..                  | 831     | 920       | 980     | 1,053    | ..                            |
| Bulopa .. ..                  | 631     | 615       | 529     | 927      | 357                           |
| Nawanzu .. ..                 | 1,203   | 1,192     | 1,531   | 1,754    | 287                           |
| Busoga Means ..               | 1,037   | 1,044     | 1,148   | 1,413    | 148                           |

The seventeen individual trials averaged 1,291 lbs. per acre of seed cotton, and 1,087 lbs. per acre of first quality cotton. This is the highest average yield yet obtained in this series of trials, and is equivalent to over three-quarters of a bale per acre of first quality lint. Owing to the low value of second and third quality cotton at the present time, most interest is attached to the yields of first quality cotton at the different centres summarised above.

The salient results are:—

(i) The low yields of S.G.29 compared with the new varieties, even in a season of high yield.

(ii) The conspicuous success of S.P.102 in the second series of Busoga trials.

(iii) The good performance of N.17 taken as a whole.

(iv) S.P.84 gave unexpectedly high yields compared with S.P.20 despite being a rather more "delicate" cotton than its prototype S.P.20. These yields should be considered in conjunction with the very satisfactory spinning results of S.P.84,

(v) The interaction of variety by centre was significant in the northern N.17 area, and in the S.G.29 area, chiefly because of the variable behaviour of S.P.90. The strain is very susceptible to Jassids and yielded badly in areas with high Jassid infestation.

The following table summarises the results of Black Arm lesion counts made on all the District Variety Trials.

*Mean Black Arm Lesions per Plant.*

| Centres.                |    | N.17.   | S.P.20.   | S.P.84. | S.P.90.  | Least significant difference. |
|-------------------------|----|---------|-----------|---------|----------|-------------------------------|
| Vukula                  | .. | 1.11    | 0.47      | 0.70    | 0.74     | ..                            |
| Bugaya                  | .. | 0.83    | 0.24      | 0.55    | 0.50     | 0.35                          |
| Bulopa                  | .. | 0.35    | 0.33      | 0.25    | 0.28     | ..                            |
| Nawanzu                 | .. | 0.75    | 0.46      | 0.54    | 0.81     | ..                            |
| Busoga Means            |    | 0.77    | 0.38      | 0.51    | 0.58     | 0.18                          |
| Kitgum                  | .. | 1.89    | 0.74      | 1.67    | 0.75     | 0.52                          |
| Ngetta                  | .. | 1.15    | 0.48      | 0.68    | 0.81     | ..                            |
| Aduku                   | .. | 1.67    | 0.52      | 1.45    | 0.46     | 0.60                          |
| Kaheramaido             | .. | 1.42    | 0.48      | 0.97    | 0.79     | ..                            |
| Northern Province Means |    | 1.53    | 0.56      | 1.19    | 0.70     | 0.26                          |
|                         |    | S.G.29. | S.P.20.   | S.P.84. | S.P.90.  |                               |
| Nyero                   | .. | 1.33    | 0.28      | 0.34    | 0.30     | 0.76                          |
| Sererere                | .. | 1.44    | 0.48      | 0.89    | 0.59     | 0.48                          |
| Bukedea                 | .. | 1.40    | 0.44      | 0.63    | 0.74     | 0.18                          |
| Kibale                  | .. | 1.26    | 0.39      | 0.49    | 0.40     | 0.19                          |
| Mulanda                 | .. | 1.73    | 0.27      | 0.39    | 0.34     | 0.26                          |
| "Bukedi" Means          |    | 1.43    | 0.47      | 0.69    | 0.59     | 0.20                          |
|                         |    | N.17.   | N.17 M.1. | B.P.52. | S.P.102. |                               |
| Vukula                  | .. | 1.17    | 1.14      | 1.77    | 0.25     | 0.42                          |
| Bugaya                  | .. | 0.77    | 0.57      | 1.16    | 0.29     | 0.33                          |
| Bulopa                  | .. | 0.78    | 1.02      | 1.07    | 0.35     | 0.49                          |
| Nawanzu                 | .. | 0.82    | 0.75      | 0.88    | 0.19     | ..                            |
| Busoga Means            |    | 0.89    | 0.87      | 1.22    | 0.27     | 0.14                          |

NOTE.—Katakwi not counted.

The chief conclusions to be drawn from the Black Arm lesion counts are:—

(i) The two control varieties N.17 and S.G.29 are consistently more susceptible than any of the S.P. varieties.

(ii) Mass selection in N.17 (*i.e.*, the M.1 population) has not resulted in an increase of resistance.

(iii) B.P.52 from Bukalasa is too susceptible to be considered for increase East of the Nile, being significantly more susceptible than the control N.17.

(iv) S.P.102 is the most resistant of all varieties.

(v) S.P.84 is on the whole more susceptible than S.P.20, but is still better than the control.

## Results of Examination of Seed Cotton Samples taken while making the 1937 Cotton Crop Estimate Traverses.

### *N.17 Areas.*

| District, |    | L.L.<br>mm. | S.E.<br>mm. | G.O.T.% | Wt. of<br>100 seeds<br>gms. | Lint from<br>100 seeds<br>gms. |
|-----------|----|-------------|-------------|---------|-----------------------------|--------------------------------|
| Busoga .. | .. | 30.86       | ±0.12       | 31.5    | 12.1                        | 5.6                            |
| Lango ..  | .. | 30.86       | ±0.15       | 31.5    | 12.6                        | 5.8                            |
| Chua ..   | .. | 30.13       | ±0.23       | 32.5    | 11.4                        | 5.5                            |

### *S.G.29 Areas.*

|                  |    |       |       |      |      |     |
|------------------|----|-------|-------|------|------|-----|
| Budama ..        | .. | 29.84 | ±0.16 | 34.5 | 12.0 | 6.3 |
| South Bugishu .. | .. | 30.52 | ±0.23 | 32.0 | 12.3 | 5.8 |
| Bugwere ..       | .. | 31.36 | ±0.21 | 31.5 | 11.9 | 5.5 |
| North Bugishu .. | .. | 30.73 | ±0.22 | 31.0 | 11.0 | 4.9 |
| Teso ..          | .. | 29.73 | ±0.15 | 33.5 | 11.6 | 5.8 |
| Gulu ..          | .. | 30.37 | ±0.22 | 33.0 | 12.6 | 6.2 |

It can be seen that Lint Length and Ginning Percentage are negatively correlated.

### *Percentage Proportion of Seed Types by Weight.*

|                  |     | Heavy Fuzz<br>% | Normal Fuzz<br>% | Green Fuzz<br>% | Naked<br>% | Gross<br>Impurity<br>% |
|------------------|-----|-----------------|------------------|-----------------|------------|------------------------|
| <i>N.17.</i>     |     |                 |                  |                 |            |                        |
| Busoga ..        | ..  | 65              | 13               | 1               | 21         | 35                     |
| Lango ..         | ..  | 76              | 14               | 1               | 9          | 24                     |
| Chua ..          | ... | 74              | 14               | 1               | 11         | 26                     |
| <i>S.G.29.</i>   |     |                 |                  |                 |            |                        |
| Budama ..        | ..  | 53              | 24               | 2               | 21         | 47                     |
| South Bugishu .. | ..  | 68              | 15               | 2               | 15         | 32                     |
| Bugwere ..       | ..  | 67              | 21               | 1               | 11         | 33                     |
| North Bugishu .. | ..  | 66              | 23               | 1               | 10         | 34                     |
| Teso ..          | ..  | 90              | 7                | 1               | 2          | 10                     |
| Gulu ..          | ..  | 80              | 16               | 0               | 4          | 20                     |

The total impurity of Budama S.G.29 is very striking. S.G.29, which was last distributed to Budama, South Bugishu, Bugwere and North Bugishu during the two seasons 1933/34 and 1934/35, shows marked deterioration in these districts. On the other hand it has stayed comparatively pure in Teso.

### Cotton Seed Multiplication.

#### (1) *Two-acre Increase.*

S.P.102 gave 1,180 lbs. of seed cotton per acre on the mangum-terraced two-acre increase plot (Block I). Of an original stand of 10,090 plants, 146 were rogued out as they showed signs of Black Arm disease. 522 plants showed very slight signs of the disease, but were not rogued. This was easily the best cotton on the Farm; the grade was particularly good, only 15.5% of the total crop being below first quality.

#### (2) *4-acre Increase.*

S.P.84 planted on 28.2 acres of the 1937 Farm gave an average yield of 654 lbs. of seed cotton per acre. The May sown cotton averaged 586 lbs. and the June sowings 749 lbs. per acre. This was planted as a safeguard as at one time it was not certain that there was enough S.P.84 seed to plant up the Mulondo Segregated Area.



## Cotton Seed Multiplication, Segregated Areas.

### (1) *Mulondo Area.*

S.P.84 was planted over 348 acres; of this area 109 acres were planted in July and August, and owing to drought conditions either germinated very badly or gave next to no crop. The whole area averaged 193 lbs. of seed cotton per acre. The total rainfall for the period May–December inclusive was only 24.05 inches; the rainfall at Serere for the same period totalled 45.13 inches. It is not surprising that exceptionally low yields resulted.

### (2) *Labori—Kadunguru.*

S.P.20 grown in Mulondo in the previous season was planted in the second Segregated area.

Labori, which experienced the same sort of rainfall as Mulondo averaged 184 lbs. per acre; whereas Kadunguru, where conditions were much more favourable, gave 385 lbs. per acre.

The whole area averaged 319 lbs. per acre as compared with a yield of 193 lbs. per acre from S.G.29 in the previous season.

## Spinning Tests.

### (1) *Empire Cotton Growing Corporation.*

Samples of the 1936/37 crop were submitted to the Shirley Institute by courtesy of the Empire Cotton Growing Corporation. The following is a general summary of the results.

“S.G.29 (Serere) and S.P.102 (Serere) are the longest samples, while S.P.20 is the shortest.

N.17 (Busoga Variety Trial) has the lowest hair-weight, and is the strongest sample. S.G.29 (Serere) is nearly as strong as the N.17 sample, but is much inferior in appearance.

Judged by both yarn strength and yarn appearance S.P.84 (Serere) is the next best to N.17 (Busoga).”

Making allowances for “place effect” this is a very favourable report for S.P.84.

### *Count × Strength Constants.*

| Variety.      | Where grown | at 30's. | at 50's. | at 60's. | Brokers' valuation*. |
|---------------|-------------|----------|----------|----------|----------------------|
| S.P.84 .. ..  | Serere      | 2,417    | 2,199    | 1,909    | 120 on               |
| S.G.29 .. ..  | Serere      | 2,406    | 2,232    | 2,064    | 110 on               |
| N.17 .. ..    | Busoga      | 2,456    | 2,337    | 2,070    | 120 on               |
| S.P.20 .. ..  | Busoga      | 2,173    | 1,937    | ..       | 100 on               |
| S.P.20 .. ..  | Serere      | 2,017    | 1,832    | 1,495    | 100 on               |
| S.P.102 .. .. | Serere      | 2,264    | 1,996    | 1,730    | Not valued.          |

\* Based on January, 1938, American Middling Futures at 4.75d.

It is only fair to add that the sample of S.P.102 was grown on poor soil, and the lint sent for test matured very late in the season owing to the plot being nearly grazed to the ground by cattle.

(2) *Indian Central Cotton Committee.*

The following report was received from the Indian Central Cotton Committee by courtesy of Messrs. The Liverpool Uganda Company, Ltd.

"S.P.84 (Serere 1936/37) has given practically the same results as A.R. Jinja of this season (1936/37), while its performance is somewhat better than that of A.R. Kampala, and definitely better than that of A.R. Busoga."

The following summarises the Indian Central Cotton Committee's reports for the last two seasons.

| Year.   | Variety.    | Count $\times$ Strength Product |          |          | Waste %         |                 |             |                    |
|---------|-------------|---------------------------------|----------|----------|-----------------|-----------------|-------------|--------------------|
|         |             | at 30's.                        | at 40's. | at 50's. | Blow Room Loss. | Card Room Loss. | Total Loss. | Av. neps per yard. |
| 1935/36 | S.G.29      | 2,127                           | 1,912    | 1,790    | 6.6             | 9.2             | 15.8        | 4.2                |
|         | S.P.84      | 2,193                           | 2,064    | 1,800    | 2.9             | 8.4             | 11.3        | 1.4                |
| 1936/37 | S.G.29      | 2,163                           | 1,944    | 1,755    | 5.4             | 9.1             | 14.5        | 2.1                |
|         | S.P.84      | 2,214                           | 2,080    | 1,830    | 3.6             | 8.8             | 12.4        | 3.8                |
| 1936/37 | Busoga N.17 | 1,875                           | 1,840    | 1,685    | 4.8             | 8.2             | 13.0        | 2.3                |
| 1936/37 | Buganda     | 2,013                           | 1,772    | 1,570    | 2.8             | 8.1             | 10.9        | 0.9                |
|         | Local       | 2,226                           | 1,992    | 1,830    | 3.2             | 9.8             | 13.0        | 4.0                |

In the above tests S.P.84 is superior to S.G.29 in every respect except neps per yard. In the latter case the two year's results are at variance. Furthermore S.P.84 is superior to Busoga N.17 and the equal of Buganda Local of the same year. Despite complaints it is noticeable that Buganda Local is superior to Busoga N.17 in this test.

**Eleusine Coracana.***Variety Trial.*

8  $\times$  8 Latin Square.

Plots 11'  $\times$  11'.

Spacing 6"  $\times$  6".

*Yields per Acre. Lbs.*

| Varieties.                         | In head. | Grain. | Threshing outturn % |
|------------------------------------|----------|--------|---------------------|
| Emoru (Lango) .. ..                | 1,674    | 1,265  | 75.5                |
| Engenyi (Teso) .. ..               | 1,517    | 1,094  | 72.1                |
| Okwakoit (Teso) .. ..              | 1,449    | 977    | 67.4                |
| Local .. ..                        | 1,409    | 1,040  | 73.8                |
| Okiringi (Lango) .. ..             | 1,382    | 1,058  | 76.5                |
| Emiroit (Teso) .. ..               | 1,359    | 1,022  | 75.2                |
| Engomu (Teso) .. ..                | 1,305    | 941    | 72.1                |
| Okwang (Teso) .. ..                | 1,157    | 720    | 62.3                |
| Least significant difference .. .. | ..       | 256    | ..                  |

While the yields are slightly lower than in the previous season, reference to the 1936/37 report will show that the varieties have yielded

in the same order for both seasons. The low threshing percentages of Okwakoit and Okwang are of interest.

### *Breeding Plot.*

A large number of single plant selections were sown, but owing to reasons which are at present not understood, all the progeny grew out as "Ekitu". The latter is the Teso name for a type of *Eleusine* which is valueless for food purposes, the grain being extremely small and hard. At one time it was thought that "Ekitu" was sterile *Eleusine*, but the writer has shown that it can be grown from seed. The whole question is now being investigated; as a start attempts have been made to cross *Eleusine* and "Ekitu". Needless to say the selection work has received a severe set back.

### **Groundnuts.**

#### *Variety Trial.*

The lay-out was in the form of 12 randomised blocks, and the sub-plots were 27'×27' and a spacing of 6"×6" was used throughout. The varieties included Local Spreading, four Spreading selections and five Bunch type selections.

The results are summarised below:—

| Variety.                      |    |    |    | Mean yield per acre<br>lbs. unshelled nuts. | Mean yield per acre<br>lbs. unshelled nuts. |
|-------------------------------|----|----|----|---------------------------------------------|---------------------------------------------|
| Local Spreading               | .. | .. | .. | 492.0                                       | Spreading types.<br>485.1                   |
| Spreading No. 183             | .. | .. | .. | 510.4                                       |                                             |
| Spreading No. 194             | .. | .. | .. | 486.0                                       |                                             |
| Spreading No. 195             | .. | .. | .. | 442.7                                       |                                             |
| Spreading No. 198             | .. | .. | .. | 494.5                                       |                                             |
| Bunch No. 228                 | .. | .. | .. | 495.5                                       | Bunch types.<br>523.3                       |
| Bunch No. 235                 | .. | .. | .. | 458.1                                       |                                             |
| Bunch No. 239                 | .. | .. | .. | 627.9                                       |                                             |
| Bunch No. 245                 | .. | .. | .. | 557.7                                       |                                             |
| Bunch No. 246                 | .. | .. | .. | 477.5                                       |                                             |
| Least significant differences | .. | .. | .. | 90.6                                        | None.                                       |

The yields are extremely low, in fact the 1937 season was the worst for groundnuts since selection work commenced on this crop.

Superimposed on 10 of the 12 blocks was a subsidiary experiment to test two weedings against three weedings. No significant difference between these two treatments was obtained, nor was the interaction of varieties×weedings significant.

The chief conclusions are:—

(i) Bunch No. 239 has given significantly higher yields than the remaining varieties with the exception of Bunch No. 245.

(ii) Bunch No. 245 has given higher yields than Spreading No. 195 and Bunch No. 235.

(iii) The two most successful varieties are derived from Spanish No. 68/6 from South Africa (No. 239) and from African Bunch from South Africa (No. 245).

### *Breeding Plot and Increase Plots.*

A large number of single plant selections of both Spreading and Bunch types were planted, also a number of small increase plots. Owing to the season yields were very poor and little useful data were obtained.

## **Sorghum.**

### *Variety Trial.*

Ten varieties tested in five randomised blocks. Results summarised in the following table:—

| No.                             | Vernacular name.      | Tillers<br>per Plant. | Total wt.<br>of Straw<br>lbs. | Total wt.<br>of Heads<br>lbs. | Total wt.<br>of Grain<br>lbs. | Threshing<br>% |
|---------------------------------|-----------------------|-----------------------|-------------------------------|-------------------------------|-------------------------------|----------------|
| T.15                            | Kitirima (Teso) ..    | 1.50                  | 281                           | 22.31                         | 17.49                         | 78.4           |
| T.9                             | Aurien (Teso) ..      | 1.26                  | 210                           | 17.57                         | 11.92                         | 67.8           |
| T.7                             | Enyango (Teso) ..     | 1.29                  | 345                           | 17.62                         | 11.53                         | 65.4           |
| T.18                            | Okwakoit (Teso) ..    | 1.30                  | 193                           | 16.67                         | 10.92                         | 65.5           |
| K.2                             | Dobbs sorghum (Kenya) | 1.47                  | 273                           | 16.02                         | 10.88                         | 67.9           |
| K.6                             | Kano sorghum (Kenya)  | 1.37                  | 195                           | 15.69                         | 10.64                         | 67.8           |
| L.4                             | Enyang (Lango) ..     | 1.40                  | 342                           | 15.70                         | 9.35                          | 59.6           |
| L.1                             | Oryemo (Lango) ..     | 1.29                  | 260                           | 13.12                         | 7.29                          | 55.6           |
| L.2                             | Edyama (Lango) ..     | 1.24                  | 302                           | 8.99                          | 4.66                          | 51.8           |
| T.8                             | Etiri (Teso) ..       | 1.34                  | 284                           | 5.45                          | 2.29                          | 42.0           |
| Least significant difference .. |                       | ..                    | 50                            | 5.79                          | 5.21                          | ..             |

The Teso variety T.18 and the Kenya "Kano" Sorghum (K.6) appear to be identical.

Varieties T.7, L.4 and L.2 have been selected for silage production owing to their high straw yield.

Kitirima (T.15) the highest yielder is an early maturing short strawed variety with red-brown grain. Despite its high yield it was slightly damaged by birds and can be classed as mid-way between the hard grained and the soft grained sorghums. The Lango variety L.1 was very badly attacked by birds.

The threshing out-turns are of interest; and it appears that there is a positive correlation between low yield and low threshing percentage.

### *Breeding Plot.*

Single plant selections were made from a collection of varieties from Teso, Lango and Bunyoro Districts, and from Tanganyika, the Sudan and Kenya. This collection has been added to, and we now have over one hundred varieties to work on. Observations on resistance to birds, weight of straw, earliness, etc., are being continued. Eighteen of the more promising varieties were selected for a variety trial for 1938.

## **Permanent Manurial Trial.**

A 5×5 Latin Square was laid down on Block 4 of the Old Farm in 1933, under the following rotation:—

1st year— { Green Manure (after application of the manures).  
Cotton.



LBS/ACRE.

1100

1000

900

800

700

300

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

- 2nd year— { *Eleusine coracana*.  
Cotton.
- 3rd year— { Groundnuts.  
Green Manure.
- 4th year—As in first year.

The Green Manures were *Crotalaria juncea* in 1933, and *Stizolobium* from 1935 onwards.

The manurial treatments applied at three years intervals before planting the green manure in the first course are:—

1. Control; no manure.
2. Lime two tons per acre.
3. 10 tons Farmyard Manure per acre.
4. 20 tons Farmyard Manure per acre.
5. 30 tons Farmyard Manure per acre.

The following table summarises the results to date:—

*Yields per Acre. Lbs.*

| Year.                   | 1933 34 | 1934           | 1934 35 | 1935         | 1936 37 | 1937           | 1937 38 |
|-------------------------|---------|----------------|---------|--------------|---------|----------------|---------|
| Crop.                   | Cotton. | Finger Millet. | Cotton. | Ground nuts. | Cotton. | Finger Millet. | Cotton. |
| Control .. ..           | 390     | 1,861          | 445     | 275          | 560     | 441            | 431     |
| Lime 2 tons .. ..       | 332     | 2,372          | 410     | 252          | 574     | 608            | 537     |
| 10 tons F.Y.M. ..       | 390     | 2,403          | 579     | 275          | 755     | 589            | 859     |
| 20 tons F.Y.M. ..       | 364     | 2,193          | 567     | 293          | 746     | 608            | 884     |
| 30 tons F.Y.M. ..       | 283     | 2,399          | 577     | 306          | 798     | 768            | 1,007   |
| Significant differences | none    | none           | 130     | none         | 150     | none           | 179     |

Cotton : yields of total seed cotton.

Millet : yields of unthreshed heads.

Groundnuts : yields of unshelled nuts.

It will be seen that the last cotton crop is the largest since the beginning of the experiment, and while the F.Y.M. treatments have given their highest yield, both Control and Lime have given lower yields than in 1936/37.

One can conclude therefore that Green Manure only, and Lime (two tons per acre) plus Green Manure, are not keeping up fertility, whereas the three farmyard manure treatments with green manure have resulted in increased fertility after seven crops.

Further, a glance at the graph of cotton yields shows that the optimum dressing of farmyard manure is more than 30 tons per acre. The latter amount is of course uneconomic, but it is of interest when compared with the results obtained in Nigeria and Tanganyika with very small dressings of farmyard manure.

It is also worthy of note that the finger millet and groundnut crops have not as yet responded to a significant extent to the three levels of farmyard manure, and the former in fact appears to be giving reduced yields as the experiment progresses. The yields of groundnuts in 1935

were extraordinarily low. All the plots, irrespective of treatment now have the appearance of light, compacted, run-down soil; in fact it is hard to believe that such soil could give yields of 1,000 lbs. per acre of seed cotton. One is forced to conclude therefore that the deep-rooted crop (cotton) is feeding on plant nutrients which have been leached down into the lower soil levels, while the surface feeding crops (millets and groundnuts) are being virtually starved.

### Summary.

For the third successive season high yields of cotton were obtained at Serere and in most districts East of the Nile.

The yields of the District Variety Trials are the highest recorded since these trials were commenced.

Once again results point to N.17 being a more successful cotton than S.G.29 when in general cultivation.

S.P.84 and S.P.102, two very promising new strains, did extremely well. The former is derived from U.4.4.2 and has come through three seasons' spinning tests with flying colours. The latter, a hybrid found in a S.G.29 reselection, is the most resistant strain yet produced to Black Arm, Jassid and *Lygus*. It also carries lint classed by local brokers as the equal of S.G.29.

Early planting of cotton was not so successful as usual.

Very poor yields of groundnuts were obtained, while the yields of finger millet were slightly below average.

H. RIVERS HOSKING,

*Botanist.*

### (iii) REPORT OF THE BOTANIST, KAMPALA.

1. This report embodies the more important results on the Kampala Plantation, but there is less to relate than in the past as the plantation is being given up—a considerable portion already has been abandoned—and no new experiments on permanent crops can be initiated until the laboratories have been transferred to Kawanda. In addition, the Botanist was out of the country for most of the twelve months under review; he left Uganda in May, 1937, visited Nyasaland and Ceylon to study tea growing before proceeding on leave and did not return to the Protectorate until the end of March, 1938. Mr. Chandler continued to supervise the Kampala Plantation and the Botanic Gardens, Entebbe, but there was no continuous relief for the scientific work—Mr. J. D. Jameson acted as Botanist in July and August and Mr. D. R. N. Brown from November, 1937, to March, 1938.

### Meteorology.

2. The total rainfall for the year was 50.74 inches, a figure one inch above the average, but it was very unevenly distributed; April and May were very wet but subsequently there was little rain until November,



when 10.75 inches fell. The temperatures were as usual—the mean maximum in the shade was 81.2°F. and the absolute maximum, 87°F., was recorded in January, February and September: the mean minimum shade temperature was 60.9°F., the absolute minimum being 53°F., in January.

### Coffee.

#### *Selection and Breeding.*

3. As was mentioned in the last annual report, the most important work has been the establishment at Kawanda of all the desirable types of *Robusta* coffee that are available. The trees, planted in 1935, have commenced to fruit, and individual tree records are being kept of the yields in grams of fresh cherry—it is not possible to prepare the bean separately for each tree when the numbers are so large. The labelling of the trees has been a lengthy process but small tabs of thin sheet brass, on which the numbers are indented with a hard pencil, attached to the stems with long loops of brass wire (to allow for growth) have proved to be cheap and convenient, showing promise of lasting well.

4. The differences in growth between the erect *Robusta* and the spreading *Nganda* trees continue to be most noticeable—the latter are much more compact, with smaller leaves than the former. The efficiency of the method employed to make the *Nganda* trees spread and to repress their early cropping is now amply demonstrated, for, while many of the temporary single stem trees are fruiting so heavily that some of their primary branches will die, yet the spreading (permanent) trees are producing little fruit and are in more vigorous vegetative growth. In Uganda, where the overbearing of young coffee has been the cause of so much trouble, this effect is of great importance, especially in the coffee grown by Africans, who would be averse to stripping the first crops in order to benefit the subsequent health of the trees. The soil on which the coffee is grown at Kawanda is thin, on a slope facing west and, in consequence, many of the trees suffered severely during the pronounced drought at the beginning of 1938. Some of the *Nganda* trees were badly affected—their young leaves were very dwarfed and contorted—but with the advent of the rains, the foliage became normal. It is considered advisable to provide a thin canopy of shade to break the force of the afternoon sun and seedlings of *Albizzia marginata* (*A. stipulata*) are being raised for that purpose. There still remain a few blanks in the rows planted in 1935, in spite of replanting in 1937 and 1938, for it is very difficult to establish coffee on the old house sites and root disease (*Armillaria mellea*) has killed one or two trees in other places.

5. The plots planted in April, 1937, were subjected to very dry weather during the latter part of the year, but in spite of the fact that the seedlings were larger than usual, a high proportion survived; in only one case (selection No. 243) were small seedlings used and most of these were killed. For the replanting, done in the current season, plants from the same batches have had to be put out and they were of course even

bigger, some having stems one inch in diameter at ground level; they have been lifted from the nurseries at Kampala, cut back to form "stumps", taken to Kawanda and planted the next day, yet most of them seem to be growing. Owing to the drought the 1937 plantings at Kawanda were very stunted until April, 1938, but they have now made sufficient growth for training to be started; as with the earlier blocks, the permanent *Robusta* trees are on the Agobiada system, the permanent *Nganda* trees are on the spreading system, and the temporary trees, interplanted in both types, are on the single stem system.

6. In addition to the infilling of blanks in the existing blocks of coffee a little new planting has been done in May. A small number of plants raised from self pollinated Java selections (Nos. 105/03, 83, 59/01) were put out, together with progeny rows of open pollinated selections from Java strains Nos. 1/14, 1/15, 24/13, 56/20 and 94/2. Short observation rows were planted of *Coffea arabica* var. *Maragogipe* and four Kenya selections, of six coffee hybrids, of two strains of wild *Robusta* coffee from the Budongo and the Zoka forests, and of *Coffea Dybowskii*.

#### Experiments.

7. *Robusta* Coffee Pruning Experiment (Plot No. 4 Kampala Plantation).—The yields from this experiment, which was described in the 1935 report, have been:—

| Method of pruning.     |    |    | Average yields in ozs. of<br>fresh cherry per tree. |       |        |
|------------------------|----|----|-----------------------------------------------------|-------|--------|
|                        |    |    | 1932-36.                                            | 1937. | Total. |
| Single stem            | .. | .. | 729                                                 | 143   | 872    |
| Agobiada               | .. | .. | 973                                                 | 175   | 1,048  |
| Multiple stem          | .. | .. | 889                                                 | 175   | 1,064  |
| Modified multiple stem | .. | .. | 816                                                 | 161   | 977    |
| Free multiple stem     | .. | .. | 842                                                 | 178   | 1,020  |
| "Kinawa"               | .. | .. | 864                                                 | 179   | 1,043  |

The yields are less than those recorded in the three previous seasons, a fact no doubt due in part to the close spacing (8 feet square) which does not allow the proper development of the trees. The average production per tree in less than eight years after planting has amounted to 1,004 ozs. of fresh cherry; the average ratio of dry beans to fresh cherry is 22%, and the yield therefore corresponds to nearly 14 lbs. of dry beans per tree or over four tons per acre, a very satisfactory figure considering the poor soil which covers part of the plot.

8. Records of the *Arabica* coffee pruning experiment and of the Soil Treatment experiment have been discontinued, in view of the abandonment of the plantation.

#### Tea.

9. The seedlings of Dhonjan and Betjan jats, sown at Entebbe, made excellent growth, and in April supplies were planted out in the blanks of the tea seed plots at Kitabi and Entebbe. The Dangri and Rajghur jats, sown at Kampala, were not so successful for the bed in

which they were planted became waterlogged, and they had to be transferred to a drier situation. Most of the seedlings of the introduced jats at Kawanda made good growth, but some beds there—especially those of the Dahootea jat from Kampala—suffered badly from eelworm attack. An investigation of the seasonal variation in the germination of seed from the Kampala plot has been in progress during the year, but has not been completed.

### Fixed Oil Plants.

10. *Oil Palm*.—The plot on the Botanic Gardens was greatly improved by the construction of proper drains; the soil is now much drier and the oil palms, planted in 1934, have made very good growth and some commenced to fruit. Two rows each of seven plants of the progeny of the Malay oil palm selection growing at Kampala were planted in May: seedlings of other good Malay palms are being raised to fill in the short rows at the end of the Entebbe plot.

11. *Castor Seed*.—A plot was sown on the Kampala Plantation in April, 1937, containing progeny rows of ten selections from the 1936 crop. Yield and habit are the two characters to which most attention has been paid as their importance is greater than that of any differences there may be in the oil content of the seed. The production of fruit was very satisfactory—the average for the 130 plants on the plot was 1,095 g. of seed per plant: a wide spacing ( $10' \times 10'$ ) was employed in order to allow full development of the plants, but the yield corresponded to over nine cwts. per acre. Owing to the long period over which the crop ripens, there would be little financial return if the cost of picking the fruits were taken into account.

### Spices and Condiments.

12. Selection of Japanese Chillies was continued at Kampala, although many of the plants were attacked by a mosaic disease and Wilt (*Fusarium* sp.) which greatly stunted their growth. Propagation of the Vanilla on the *Gliricidia* plot was continued, and a few pods were produced from flowers which were self pollinated. It has been noticed that some of the vines were more vigorous than the others, and it appears that the large ones must be *Vanilla pompona* as they have the thick stems, the larger leaves, yellow flowers and the fruits (triangular in section) that are typical of that species. There is, however, no record of the introduction of *Vanilla pompona*, but only of *V. planifolia*: another species (? *V. imperialis*) native to Uganda is represented in the Botanic Gardens, Entebbe, and is being propagated in order that a sample of its fruits may be prepared.

### Drugs and Insecticides.

13. *Tephrosia vogelii*.—A report was received on insecticide tests carried out at Rothamstead on three samples of leaves of *Tephrosia Vogelii*:—

- A. from Fort Wavertree Estate, Toro,
- B. white flowered variety from Kampala Plantation,
- C. purple flowered variety from Kampala Plantation.

Mr. Tattersfield, who kindly carried out the tests, reported that: "‘A’ and ‘B’ are very much the same in quality, whereas ‘C’ is rather more toxic than either . . . I should gravely question whether any of the plants have much prospect of competing with Derris or Cube of good quality in the markets of Europe or America. Unfortunately we do not know what is the best time of taking the foliage, nevertheless, my opinion is that unless greatly improved by selection, if that is feasible (and it is doubtful) it would appear as if these plants would only have a local use as insecticides."

14. *Derris elliptica*.—A consignment of 500 plants of *Derris elliptica*, received from Amani in July, was planted out at Kampala at spacings of 2½ feet by 2½ feet and 3 feet by 3 feet. The plants made good progress, though many shoots were attacked by *Fusarium* sp. and a few died back from the disease.

### Fibres.

15. *Abroma augusta*.—Cutting of the stems and preparation of the fibre was continued but as the plants have become older the yields from successive ratoons diminish; many plants have been stunted with Wilt disease and some have died. The area under the crop therefore has been increased by three acres in order to supply more material for the bulk sample required; as before, considerable difficulty has been found in obtaining a good stand of plants, owing to the poor germination of the seed.

16. *Manila Hemp (Musa textilis)*.—The stools have made excellent growth; a few pseudostems were cut and the fibre extracted to make a specimen for the Nakuru Show—the quality was much better than before, and it is hoped to prepare a good sample for report during the current year.

### Sugar Cane.

17. About twenty cuttings of each of the varieties below were received from Amani in May:—

CO404, CO407, CO408, CO411, CO417, CP807, POJ2745, POJ2875.

The cuttings have been planted in the reclaimed swamp at Kampala and will be propagated for distribution.

### Fruits.

18. *Citrus*.—Budding was continued, using the Rough Lemon stocks as before, and all the more useful introduced varieties (a few have been shown to be of no value at Kampala) have been propagated ready for planting at Kawanda; some few trees already have been established there and are making fair growth.

### Introductions.

19. Successful introduction of economic importance included:—

*Caryocar nuciferum* from British Guiana.

*Derris elliptica* from Amani.

Sugar cane, eight varieties from Amani.



20. Grateful acknowledgment is made to all those who kindly supplied seeds and plants, and to the Director and staff of the Royal Botanic Gardens, Kew, for the determination of many herbarium specimens.

A. S. THOMAS,  
*Botanist.*

#### (iv) REPORT ON THE BOTANIC GARDENS, ENTEBBE.

1. The control and supervision were both very similar to that of the past few years, with a weekly visit from the Plantation Manager and occasional visits from the Botanist or Acting Botanists: this report covers the calendar year of 1937.

#### Meteorological.

2. *Rainfall*.—The total rainfall at Entebbe, 67·32 inches, was 7·40 inches in excess of the annual mean over a period of 37 years; rain was recorded upon 184 days. The highest fall of the year, 2·18 inches, was recorded on the 1st of May.

3. *Temperatures*.—The mean maximum for the year was 77·8 degrees which is exactly the same as that for 1936. The highest temperatures recorded were 84·4 degrees on January 8th, and 84·2 degrees on September 24th. The mean minimum temperature was equal to 63·3 degrees, 3·5 degrees higher than that of last year. The lowest temperature recorded was 58·6 degrees. This occurred twice, on January 9th, and September 5th.

#### Labour.

4. No difficulty was experienced in obtaining our requirements which were on an average 80 men per month, including five men regularly employed on outside work at the Kitabe and Kitubulu Estates.

5. Attendances of the above were good as a whole, an average of 77·6 men per day resulting. Wages for unskilled labour rose slightly, the average being Shs. 12 and Shs. 13 per month.

#### Crops.

##### *Oil palms (Elaeis guineensis).*

6. Harvesting and recording the yields from individual palms on the original block were continued as before until the end of August. It was then decided to continue to record yields from the seventeen best palms only as the others had proved to be of little value and labour was needed to record from the young palms.

7. Ten of the twenty Nigerian seedlings planted during 1934 and two others from our own seed came into bearing about this time and records commenced. Most of the very earliest fruits were however empty, and it would serve no useful purpose to include the figures obtained. New development during the year consisted of clearing the unplanted

corner of the plot for further imported strains, sufficient to accommodate from 25 to 30 palms at a spacing of 30 feet by 30 feet. Seed distribution during the year amounted to 25 lbs. only, to the Agricultural Officer, Toro. *Tea* (*Thea sinensis*).

8. There is little to report about the two varieties at Entebbe and Kitabe, Betjan and Dhonjan respectively, other than that the former appears to be the quicker growing variety. A good many gaps in both plots were still unfilled at the end of the year, but large batches of seedlings are being raised for this purpose.

9. In passing, a record may be made of the excellent germination obtained from the imported seed of these two jats—Betjan 84.8% and Dhonjan 92.6%.

#### *Hydnocarpus Wightiana* and *H. anthelmintica*.

10. Except in places where the soil is very shallow good growth has been continued by both species. During the year 19 trees of the former bore fruits and 18 of the latter; figures one and two respectively above the numbers of last year.

11. Individual tree records were continued and again show *H. Wightiana* to be much more prolific with 6,331 fruits as against 158 only from *H. anthelmintica*.

#### *Coffee*.

12. The collections of both the wild Robusta types and Arabica varieties were increased during the year, and now number ten and twelve respectively. The earliest Robusta types, now about 2½ years old, are carrying small crops of fruits. Isolated plots of Kent's Arabica and Harar, intended as sources of pure seed supply, continue to be disappointing under local conditions, especially the latter.

#### *Medicinal Plants, Drugs, Condiments, Spices*.

13. There are now established in a plot allocated to such plants the following: Allspice (*Pimenta officinalis*), Annatto (*Bixa orellana*), Bay (*Pimenta acris*), Arabian Tea (*Catha edulis*), Camphor (*Cinnamomum camphor*), Cocaine (*Erythroxylum coca*), Gutta (*Palaquium javanense*), Horseradish tree (*Moringa oleifera*), Henna (*Lawsonia inermis*), Nutmeg (*Myristica fragrans*), Quinine (*Cinchona Josephiana*), and Physic nut (*Jatropha curcas*).

14. The Pepper (*Piper nigrum*) vines on the old Para rubber trees continued to flower profusely most of the year but have set no fruits.

#### *Fruit*.

15. There is still little to report under this heading as growth of most species has not been very vigorous, except in the case of the *Passiflora* spp. which have made large plants. One Mangosteen (*Garcinia mangostana*) tree planted near the fernery during 1916 produced a small first crop of fruits.

#### *Nursery*.

16. Stocks of plants were mostly well maintained as regards numbers, but certain species were more stunted owing to the low fertility

of the soil combined with water logging at some times of the year. This trouble will be remedied shortly by utilising the other portion of the nursery which has lain fallow for the last few years.

17. The distribution of plants, seeds, etc., which took place during the period under review was as under:—

|            |    |    | <i>Plants.</i> |    | <i>Seeds.</i> |  | <i>Clumps.</i> |
|------------|----|----|----------------|----|---------------|--|----------------|
| Economic   | .. | .. | 972            | .. | 7 packets     |  |                |
| Decorative | .. | .. | 2,293          | .. | 65 packets..  |  | 20             |
|            |    |    | <hr/>          |    | <hr/>         |  |                |
| TOTAL      | .. | .. | 3,265          | .. | 72 packets..  |  | 20             |
|            |    |    | <hr/>          |    | <hr/>         |  | <hr/>          |

18. From the Kitubulu Estate, *Cinchona* seed amounting to 7 lbs. 14½ ozs. was collected for one European Estate as a special order.

#### *Lawns.*

19. Some of the older stretches are badly needing attention by replanting as much of the original French grass (*Cynodon dactylon*) has died out and has been replaced by coarser grasses and weeds, many of which have the disadvantage of producing long straggling flowering stems which cause a very untidy appearance at certain periods. Little time was available to undertake this work except an area in the vicinity of the old Conifer plot, planted up with *Brachiaria decumbens*, and a smaller piece between the lake-side road and the site of the old nursery which was levelled off and filled with *Cynodon dactylon*; both had covered well at the end of the year.

#### *Flower Beds and Borders.*

20. The scattered flower beds are gradually being grassed over as the plants are being grouped more in families.

21. The double border near the nursery was quite bright at times with annuals and perennials. Several climbing plants on the long pergola running down between the above border flowered freely and more were added to the collection.

#### *Fernery.*

22. The only work of any importance was the removal of a large number of Toddy Palms (*Caryota urens*) which had become naturalised, together with a smaller number of dead or dying Raphia Palms (*Raphia munbuttorum*). Some bare spaces resulted in consequence, but were soon covered after the heavy rains during November.

#### *Flowering Plants, Shrubs and Trees.*

23. Those which flowered during the year were again numerous and included several of recent introduction. A few of the more outstanding were *Ixora congesta* (in flower for several weeks on end), *Sambucus* sp. (periodically), *Crossandra undulataefolia*, *Musa coccinea*, *Orypetalum caeruleum*, and *Bougainvillea* var. Mrs. Maclean.

24. Four exotic orchids, *Dendrobium aruenum*, *D. phalaenopsis*, *D. thrysiflorum*, and *D. densiflorum*, flowered on the tree in the fernery

and were all attractive. A number of indigenous species on the same tree also flowered and although less conspicuous were of interest.

25. Finally, mention must be made of the 20 years old clumps of Bamboos (*Bambusa vulgaris*, var. *aurea*) which flowered for the first time, and are since looking very uneven as the stems have died and have had to be cut out.

#### *Roads and Drains.*

26. Much labour has been employed on these throughout the year but chiefly on the drains within the lower levels of the gardens, more especially in the block of oil palms and on the re-opening of an old road looping around this area.

27. When completed this road should be a great improvement as it will enable visitors easy access to the new section of economic crops.

#### *Extension and Development.*

28. One of two new areas opened has been already mentioned under the heading of Oil palms. The second, which was in course of clearing and preparation towards the end of the year is situated at the opposite end of the gardens between the Para block and the patch of forest near the lake. This corner in the past was very rough being in part a disused quarry and part just scrubby vegetation. It is intended to level this area, plant it with short grass, and retain the forest as a bird sanctuary. When the scheme is complete more views of the lake will be possible from certain parts of the gardens.

#### *Introductions.*

29. Advantage was again taken of the kindness of various territories issuing lists of plants and seeds for exchange and there were acquired 79 packets of seeds (24 economic and 55 decorative), and one consignment of plants was purchased from Kenya.

#### *Visitors.*

30. With the advance of education within the Protectorate the Botanic Gardens are taking a more important place than in the past and periodical visits were made by a number of students from Makerere College and various schools, in addition to the general public.

#### *Flower Show, Entebbe.*

31. This was held by permission of His Excellency The Governor at Government House on May 23rd. The exhibit displayed by the Botanic Gardens consisted of plants of recent introduction or some which are not yet common in Uganda. A number of plants were provided as prizes for certain classes as in past years.

#### *Acknowledgments.*

32. Thanks are offered to the Officers-in-charge of the Botanic Stations who generously responded to various requests, to local residents who gave plants or seeds, and to the Officer of the local meteorological station who kindly furnished the monthly weather summaries throughout the year.

P. CHANDLER,  
*Plantation Manager.*



## REPORT ON THE PROVINCIAL PROGRAMMES OF EXPERIMENTAL WORK.

This section has been compiled from the joint report of the Senior Agricultural Officer, Kampala, and the Senior Botanist on Bukalasa Plantation, the report of the Senior Agricultural Officer, Jinja, including matter contributed by the Botanist on Serere Plantation, and the report of the Agricultural Officer in charge of the Northern Province.

### A. Cotton.

#### (1) *Cotton Sowing Date and Spacing Trial at Masafu.*

*Object.*—To obtain information with regard to the special climatic conditions met with in Samia County of Budama District.

*Lay-out.*—Twelve plots of 24 feet  $\times$  24 feet with 6 feet paths. Randomized for spacings and sowing dates.

*Results.*—

*Yields of Seed Cotton (Lbs. per Acre).*

*Sowing Dates.*

| Spacings.          | June 8th. | July 8th. | August 8th. | September 8th. | Spacing Means. |
|--------------------|-----------|-----------|-------------|----------------|----------------|
| 3' $\times$ 1' ..  | 1,286     | 1,286     | 983         | 681            | 1,059          |
| 3' $\times$ 1½' .. | 1,134     | 1,059     | 1,134       | 454            | 945            |
| 3' $\times$ 2' ..  | 756       | 832       | 908         | 529            | 756            |
| Sowing date means  | 1,059     | 1,059     | 1,008       | 555            | 920            |

*Conclusions.*—The fourth sowing date, September 8th, yielded less than the others. There are no other significant differences, but it can be stated with reasonable certainty that a larger experiment would show the value of close spacing.

#### (2) *Sowing Date Demonstration Plots in Lango District.*

At Ngetta ten plots of equal size sown at fortnightly intervals yielded as follows:—

| Sowing Date.  | Seed Cotton<br>Lbs. per Acre. | Sowing Date.   | Seed Cotton<br>Lbs. per Acre. |
|---------------|-------------------------------|----------------|-------------------------------|
| April 23rd .. | 1,840                         | July 2nd ..    | 1,710                         |
| May 7th ..    | 1,803                         | July 16th ..   | 1,630                         |
| May 21st ..   | 2,150                         | July 30th ..   | 1,370                         |
| June 4th ..   | 1,790                         | August 13th .. | 1,368                         |
| June 18th ..  | 1,790                         | August 27th .. | 490                           |

Five plots at each of eight centres in the district yielded as follows:—

*Seed Cotton (Lbs. per Acre).*

| Centre.               | May.  | June. | July. | August. | September. | Mean. |
|-----------------------|-------|-------|-------|---------|------------|-------|
| Akokoro ..            | 90    | 180   | 810   | 390     | 60         | 306   |
| Aduku ..              | 1,350 | 1,620 | 1,020 | 330     | 180        | 900   |
| Ogur ..               | 1,590 | 1,050 | 750   | 360     | 120        | 774   |
| Orumo ..              | 180   | 240   | 120   | 120     | 0          | 132   |
| Kaberaimaido ..       | 1,110 | 1,440 | 1,410 | 900     | 210        | 1,014 |
| Awelo ..              | 780   | 1,080 | 750   | 960     | 120        | 738   |
| Dokolo ..             | 270   | 330   | 240   | 120     | 90         | 210   |
| Ngai ..               | 1,350 | 1,860 | 1,140 | 630     | 150        | 1,026 |
| Mean (sig. diff. 329) | 840   | 975   | 780   | 476     | 116        | 638   |
| % Saff ..             | 65    | 65    | 72    | 67      | 48         | ..    |

These plots served to demonstrate to cultivators the advantage of early planting under average conditions. The high proportion of clean cotton in the July-sown cotton constitutes a point of interest inasmuch as it bears out the local natives' contention that July-sown cotton is invariably cleaner than cotton sown in any other month.

(3) *Cotton Cultivation Experiment at Bukalasa.*

*Lay-out.*—This experiment was laid down in three parts planted at three different sowing dates; within each part spacing, thinning and interplanting treatments were replicated in six blocks each completely randomized.

*Results.*—

*Yields of Seed Cotton (Lbs. per Acre).*

|                       |    |    |  | May 18th. | June 28th. | August 13th | Mean. |
|-----------------------|----|----|--|-----------|------------|-------------|-------|
| <b>Spacing.</b>       |    |    |  |           |            |             |       |
| 4 ft. × 1½ ft.        | .. | .. |  | 946       | 846        | 512         | 738   |
| 3 ft. × 1 ft.         | .. | .. |  | 1,128†    | 1,136†     | 690         | 985†  |
| <b>Thinning.</b>      |    |    |  |           |            |             |       |
| One plant per hole    | .. | .. |  | 998       | 946        | 589         | 844   |
| Two plants per hole   | .. | .. |  | 1,076     | 1,036*     | 614         | 909†  |
| <b>Interplanting.</b> |    |    |  |           |            |             |       |
| Control ..            | .. | .. |  | 1,099     | 1,044      | 638         | 927   |
| With groundnuts       | .. | .. |  | 975*      | 938†       | 565*        | 826†  |
| Mean ..               | .. | .. |  | 1,037     | 991        | 601         | 877   |

\* Difference attains 100 : 1 level of significance.

† Difference attains 1,000 : 1 level of significance.

As the sowing dates were not replicated there is no valid test of the significance of the sowing date means, but the values obtained conform with previous conclusions reached at Bukalasa. The May sown cotton was poor in appearance. The interaction between sowing dates and spacings is significant (20 : 1) and is valid. The nature of this interaction is apparent from the figures, namely, with late planting a relatively greater loss is occasioned by wide spacing. The only other significant

interaction (20 : 1) is that between thinning and interplanting for all sowing dates combined. The nature of the interaction is apparent from the following table, namely, the response to two plants per hole almost vanishes with interplanting.

*Yields of Seed Cotton (Lbs. per Acre).*

|                        | Control. | With groundnuts. | Mean. |
|------------------------|----------|------------------|-------|
| <b>Thinning.</b>       |          |                  |       |
| One plant per hole ..  | 877      | 812              | 844   |
| Two plants per hole .. | 977      | 840              | 909   |
| Mean .. ..             | 927      | 826              | 877   |

Three negative conclusions can be drawn with reasonable certainty from the analysis of this experiment, and each is unexpected:—

(a) Two plants per hole do not tend to compensate for wide spacing.

(b) The depressing effect of interplanting on the yield of cotton is not more marked at the closer spacing.

(c) The effect of interplanting on the yield of cotton is the same at all sowing dates.

Interplanting consisted of one row of groundnuts between the rows of cotton, and the yields of groundnuts from the interplanted plots were as follows:—

*Yields of Unshelled Groundnuts (Lbs. per Acre).*

|                           |     |      |     | Mean. |
|---------------------------|-----|------|-----|-------|
| <b>Spacing (cotton).</b>  |     |      |     |       |
| 4 ft. × 1½ ft. ..         | 306 | 461  | 214 | 327   |
| 3 ft. × 1 ft. ..          | 357 | 415* | 182 | 318   |
| <b>Thinning (cotton).</b> |     |      |     |       |
| One plant per hole        | 329 | 459  | 212 | 333   |
| Two plants per hole       | 334 | 418  | 185 | 312   |
| Mean .. ..                | 332 | 438  | 198 | 323   |

\* Difference attains 20 : 1 level of significance.

The interaction between sowing dates and spacings is significant (100 : 1) and is due to the anomalous behaviour in the first sowing date. The groundnut yields from the two early sowing dates are satisfactory (taking plant population into account), and more than compensate for the loss of cotton. The groundnut yields from the late sowing date are not satisfactory and there is nothing to commend interplanting in late sown cotton.

(4) *Cotton and Groundnuts Interplanting Experiments in the Eastern and Northern Provinces.*

**Object.**—To determine what interval should elapse between the planting of the two crops. It had been suggested that both cotton and groundnuts make their maximum demand for water at the inception of flowering, and that the coincidence of these demands might be responsible for the break-down of certain interplanting schemes.

*Treatments.*—

(1) Controlled Experiments at Ngetta and Serere.

(a) Cotton planted one week before groundnuts.

(b) Cotton planted one week after groundnuts.

(c) Cotton planted three weeks after groundnuts.

(d) Cotton, not interplanted, planted on the same day as (a).

(e) Cotton, not interplanted, planted on the same day as (b).

(f) Cotton, not interplanted, planted on the same day as (c).

(2) Subsidiary Experiments at Kaberamaido, Katakwe, Rappayi, Kumi and Mbale.

Treatments (a), (b) and (c) only.

*Lay-out.*—

(1) Controlled Experiments. Five blocks, sub-blocked for interplanting, each sub-block containing three randomized plots.

(2) Subsidiary Experiments. Five blocks each containing three randomized plots.

Plots: 30 ft.  $\times$  28 ft. (approximately 1/52nd acre).Spacing of cotton: 3 ft.  $\times$  1 ft.

Spacing of groundnuts: one interplanted row with plants 9 in. apart.

Sowing Date: all groundnuts sown on April 14th or thereabouts.

*Results.*—(1) *Controlled Experiments.**Yields of Seed Cotton and Unshelled Groundnuts (Lbs. per Acre).**Ngetta.*

|                       |    | Interplanted.     | Not interplanted. | Means. |
|-----------------------|----|-------------------|-------------------|--------|
| Cotton 1 week before  | .. | 949 <i>1,085*</i> | 1,178             | 1,064  |
| Cotton 1 week after   | .. | 920 <i>1,144</i>  | 1,100             | 1,010  |
| Cotton 3 weeks after  | .. | 909 <i>1,251</i>  | 902               | 906    |
| Means (sig. diff. 71) | .. | 926               | 1,060             | 993    |

*Serere.*

|                       |    |                |     |     |
|-----------------------|----|----------------|-----|-----|
| Cotton 1 week before  | .. | 645 <i>675</i> | 635 | 640 |
| Cotton 1 week after   | .. | 614 <i>560</i> | 698 | 656 |
| Cotton 3 weeks after  | .. | 591 <i>619</i> | 612 | 602 |
| Means (sig. diff. 77) | .. | 617            | 648 | 633 |

*Ngetta and Serere.*

|                       |    |                |     |     |
|-----------------------|----|----------------|-----|-----|
| Cotton 1 week before  | .. | 797 <i>880</i> | 907 | 852 |
| Cotton 1 week after   | .. | 767 <i>852</i> | 899 | 833 |
| Cotton 3 weeks after  | .. | 750 <i>935</i> | 757 | 754 |
| Means (sig. diff. 46) | .. | 772            | 854 | 813 |

\* Figures in italics denote groundnut yields.



From the evidence of the control plots it is clear that the loss of yield of cotton in the third sowing date is due to absolute sowing date and not to the interplanting scheme.

Interplanting causes an over-all reduction in the yield of cotton, but the groundnuts give a very good return when plant population is taken into account. There are no significant differences between the yields of groundnuts.

(2) *Subsidiary Experiments, including appropriate parts of the Controlled Experiments.*

*Yields of Seed Cotton (Lbs. per Acre).*

| Treatments.                         | Seed Cotton. |       |       | Least sig. diff. | Unshelled Groundnuts. |       |       | Least sig. diff. |
|-------------------------------------|--------------|-------|-------|------------------|-----------------------|-------|-------|------------------|
|                                     | (a)          | (b)   | (c)   |                  | (a)                   | (b)   | (c)   |                  |
| Ngetta.. ..                         | 949          | 920   | 909   | ..               | 1,085                 | 1,144 | 1,251 | ..               |
| Kaberauido ..                       | 1,190        | 1,142 | 1,066 | 80               | 935                   | 993   | 1,029 | ..               |
| Serere .. ..                        | 645          | 614   | 591   | ..               | 675                   | 560   | 619   | ..               |
| Katakwe .. ..                       | 112          | 109   | 78    | ..               | 1,124                 | 1,125 | 1,339 | ..               |
| Rappayi .. ..                       | 446          | 513   | 496   | ..               | 849                   | 954   | 1,032 | 130              |
| Kumi .. .. .                        | 816          | 765   | 770   | ..               | 245                   | 248   | 163   | ..               |
| Mbale .. .. .                       | 597          | 617   | 524   | ..               | 247                   | 245   | 218   | ..               |
| Seven centres ..                    | 680          | 669   | 634   | ..               | 737                   | 753   | 807   | ..               |
| Six centres excluding Ngetta .. ..  | 635          | 627   | 588   | 38               | ..                    | ..    | ..    | ..               |
| Six centres excluding Katakwe .. .. | ..           | ..    | ..    | ..               | 673                   | 691   | 718   | ..               |

NOTE.—In many of the foregoing experiments the yields are expressed in pounds per acre. These, in most cases, are rates calculated from the yields of small plots. This method is useful for purposes of comparison but it multiplies the effect of the extra care and attention which experiments receive, and produces apparent high yields which are not comparable to the yields obtained under field conditions.

The last two lines are included as the Ngetta cotton yields and Katakwe groundnut yields were very irregular.

The conclusion is the same as from the controlled experiments and must be ascribed to the same reason. This series of experiments therefore gives no support to the hypothesis which it was designed to test.

## B. Robusta Coffee.

## (1) Shade and Cover Crop Experiment at Bukalasa.

Yields: Tons Wet Cherry per Acre.

## Main Effects.

|                | No Shade. | Banana | Gliricidia. | Least Sig. Diff. | Clean Weeded | Cover Crop. | Least Sig. Diff. | Season Mean. |
|----------------|-----------|--------|-------------|------------------|--------------|-------------|------------------|--------------|
| 1932-33 ..     | 2.98      | 2.31   | 2.66        | 0.31             | 3.39         | 1.91        | 0.25             | 2.65         |
| 1933-34 ..     | 6.10      | 5.49   | 5.07        | 0.58             | 5.59         | 5.53        | ..               | 5.55         |
| 1934-35 ..     | 3.02      | 3.11   | 3.21        | ..               | 3.39         | 2.83        | 0.28             | 3.11         |
| 1935-36 ..     | 3.98      | 3.61   | 3.92        | ..               | 3.87         | 3.81        | ..               | 3.84         |
| 1936-37 ..     | 5.14      | 4.19   | 4.19        | 0.40             | 4.59         | 4.43        | ..               | 4.50         |
| 1937-38 ..     | 2.28      | 1.78   | 2.24        | 0.29             | 1.99         | 2.22        | ..               | 2.10         |
| Six seasons .. | 23.50     | 20.49  | 21.29       | 0.97             | 22.81        | 20.72       | 0.80             | 21.76        |

## Interactions.

|                | No Shade.    |             | Banana.       |             | Gliricidia.   |             | Level of Significance. |
|----------------|--------------|-------------|---------------|-------------|---------------|-------------|------------------------|
|                | Clean Weeded | Cover Crop. | Clean Weeded. | Cover Crop. | Clean Weeded. | Cover Crop. |                        |
| 1932-33 ..     | 3.91         | 2.04        | 3.04          | 1.58        | 3.22          | 2.10        | ..                     |
| 1933-34 ..     | 6.04         | 6.16        | 6.00          | 4.97        | 4.71          | 5.44        | 20:1                   |
| 1934-35 ..     | 3.34         | 2.70        | 3.52          | 2.70        | 3.31          | 3.10        | ..                     |
| 1935-36 ..     | 3.90         | 4.06        | 3.92          | 3.31        | 3.78          | 4.07        | ..                     |
| 1936-37 ..     | 5.18         | 5.10        | 4.37          | 4.01        | 4.21          | 4.16        | ..                     |
| 1937-38 ..     | 2.15         | 2.41        | 1.60          | 1.96        | 2.21          | 2.28        | ..                     |
| Six seasons .. | 24.54        | 22.48       | 22.45         | 18.53       | 21.44         | 21.16       | 100:1                  |

## Conclusions.

*Seasons.*—The first four seasons show a marked tendency to biennial cropping. The fifth season is higher than the fourth, but after two good years the sixth season shows a dramatic collapse. Many trees had to be stumped in 1937 and a great many more in 1938.

*Shades.*—"No shade" is better than Banana and *Gliricidia* and between Banana and *Gliricidia* there is no difference. "No shade" is, however, a misnomer as the plots enjoy a wind breaking effect due to the shade trees in adjacent plots. The loss of crop under Banana and *Gliricidia* is not great, especially when one remembers the food value of bananas to natives.

The interaction of Shades and Seasons is significant. Cropping is most regular under *Gliricidia*; and perhaps rather more irregular under Bananas than with "No shade".

*Ground Treatments.*—Clean Weeding is better than Cover Crop. The interaction of Ground Treatments and Seasons is significant. The clean weeded plots are more regular for the first five seasons, as the Cover Crop plots were markedly restrained in the first and third (lean) seasons. There appears to be a tendency for the Cover Crop Treatment to pick up later.

*Shades and Ground Treatments.*—The interaction between the two treatments is significant. It appears that the combination of Banana Shade and Cover Crop is particularly unsuitable; while under *Gliricidia* Shade the Ground Treatment is a matter of indifference.

The interaction of both kinds of treatment with seasons is also significant. All the Cover Crop plots are restrained in the first season. Thereafter cropping is very regular under *Gliricidia* Shade, both Ground Treatments following the same course. Under No Shade and Banana Shade, Clean Weeding gives the more regular cropping, but again there appears to be a tendency for the Cover Crop plots to pick up later.

(2) *Ground Treatment Experiment at Bukalasa.*

As the treatment yields are separated by intervals of more than 100%, analysis has been performed by logarithmic transformation. Least significant differences are therefore ratios and not numerical differences; they are shown, where they exist, by writing in parenthesis the next lowest yield removed from the actual yield by a significant interval.

*Yields: Tons Wet Cherry per Acre.*

|                 | Clean Weeded. | Mulch.      | Cover Crop.  | Weed Cover. |
|-----------------|---------------|-------------|--------------|-------------|
| 1934-35 ..      | 1.48 (0.98)   | 1.53        | 0.47         | 0.39        |
| 1935-36 ..      | 5.28          | 5.13 (3.76) | 2.02 (1.48)  | 1.00        |
| 1936-37 ..      | 3.89          | 5.66 (4.12) | 3.79         | 3.22        |
| 1937-38 ..      | 5.91 (4.43)   | 6.25        | 4.18 (3.13)  | 3.02        |
| Four seasons .. | 16.56 (14.20) | 18.57       | 10.46 (8.96) | 7.63        |

Interaction of Treatments and Seasons significant.

*Conclusions.*—The conclusions are self evident and the experiment as it now stands is a startling ocular demonstration.

(3) *Shade and Ground Treatment Experiment at Bukalasa.*

The Ground Treatments were first applied in 1937 and Cotton Seed was first applied in 1935.

*Yields: Tons Wet Cherry per Acre.*

*Main Effects.*

|                | <i>Gliricidia.</i> | No Shade. | Clean Weeded. | Full Mulch. | Alt. Raw Mulch. | Oct. to Mar. Cover. | Least. Sig. Diff. | Cotton Seed. | No C.S. | Least Sig. Diff. |
|----------------|--------------------|-----------|---------------|-------------|-----------------|---------------------|-------------------|--------------|---------|------------------|
| 1936-37 ..     | 0.36               | 0.43      | 0.43          | 0.44        | 0.35            | 0.36                | ..                | 0.50         | 0.29    | 0.09             |
| 1937-38 ..     | 1.65               | 1.69      | 2.03          | 1.26        | 1.73            | 1.66                | 0.34              | 1.91         | 1.44    | 0.14             |
| Two seasons .. | 2.01               | 2.12      | 2.46          | 1.70        | 2.08            | 2.02                | not calc.         | 2.41         | 1.73    | not calc.        |

The first table shows:—

- No over-all difference between shade and no shade.
- A marked differentiation between ground treatments as soon as these were applied.
- A large response throughout to dressings of cotton seed.

*Interactions.*

|             |    | Gliricidia.  |         | No Shade.    |         | Season Mean. |
|-------------|----|--------------|---------|--------------|---------|--------------|
|             |    | Cotton Seed. | No C.S. | Cotton Seed. | No C.S. |              |
| 1936-37..   | .. | 0.47         | 0.24    | 0.53         | 0.33    | 0.39         |
| 1937-38..   | .. | 1.94         | 1.36    | 1.87         | 1.51    | 1.67         |
| Two seasons | .. | 2.41         | 1.60    | 2.40         | 1.84    | 2.06         |

*Behaviour of Shade.*

|           |          | Block 1. | Block 2. | Block 3. | Block 4. | Block 5. |
|-----------|----------|----------|----------|----------|----------|----------|
| 1936-37.. | ..       |          |          |          |          |          |
|           | Shade    | 0.49     | 0.26     | 0.22     | 0.47     | 0.34     |
|           | No Shade | 0.71     | 0.61     | 0.22     | 0.34     | 0.28     |
| 1937-38.. | ..       |          |          |          |          |          |
|           | Shade    | 1.81     | 1.47     | 1.09     | 2.30     | 1.60     |
|           | No Shade | 2.43     | 1.89     | 1.24     | 1.81     | 1.09     |

The second table indicates, what may or may not prove to be significant in later years, that the response to cotton seed is larger under shade than without shade; which suggests that the manure works more thoroughly when protected from the sun.

The third table shows an interesting differentiation in the behaviour of shade and no shade between the five blocks of the experiment. In the first two blocks the coffee bears more heavily without shade, whereas in the last two blocks it bears less without shade; suggesting thinner soil in the last two blocks as an explanation.

No other effects are discernible so further tables illustrating other combinations of treatments are omitted.

*(4) Shade Demonstration Plots at Bukalasa.*

*Lay-out.*—Six large plots, the half of each plot planted with *Robusta* 10 ft. × 10 ft. and the other half with *Nganda* 15 ft. × 15 ft. triangular, planted in 1935.

- Shades: (a) No shade.  
 (b) Natural shade.  
 (c) *Ficus* (barkcloth).  
 (d) *Erythrina* sp.  
 (e) *Leucaena glauca*.  
 (f) (*Albizia marginata*).  
 (*Cordia* sp.).

These plots are maintained for observation purposes only.

*(5) Shade and Variety Experiment at Wanyange.*

The objects and lay-out of this experiment were detailed in Annual Report, Part II, for 1936. During 1937 the *Gliricidia* shade was cut out owing to the large amount of Mealy Bug present, and its place was taken by Giant Castor Oil. The trees bore a first small crop during 1937, the weights of wet cherry in pounds per acre being:—

|                    |    | Shaded. |    | Unshaded. |
|--------------------|----|---------|----|-----------|
| <i>Nganda</i> type | .. | 204     | .. | 231       |
| Erect type ..      | .. | 20      | .. | 116       |



(6) *Ground Cover Observation Plots at Wanyange.*

Small observation plots of three different types of ground cover were laid down at Wanyange in 1934. The treatments are given below, together with the yields to date in tons fresh cherry per acre:—

| <i>Treatments.</i>               |    |    | <i>Yields,</i> |       |        |
|----------------------------------|----|----|----------------|-------|--------|
|                                  |    |    | 1936.          | 1937. | Total. |
| <i>Cucurbita</i> sp. cover .. .. | .. | .. | 4.08           | 4.14  | 8.22   |
| Cow-pea (planted twice yearly)   | .. | .. | 3.07           | 2.91  | 5.98   |
| Elephant grass mulch .. ..       | .. | .. | 1.77           | 3.38  | 5.15   |
| Clean weeded .. ..               | .. | .. | 3.89           | 3.69  | 7.58   |

(7) *Progeny Rows at Wanyange.*

Observation rows of the progenies of six *Robusta* selections made by the Botanical Section are maintained at *Wanyange*, and yields recorded, with a view to using seed from the best trees for distribution in Busoga District.

(8) *Observation Plots in Budama District.*

Five observation plots of *Nganda* and Erect *Robusta*, shaded and unshaded, are maintained in the southern part of Budama District.

C. *Arabica* Coffee.(1) *1928 planted Cultural Experiment at Bugusege.*

The trees in this experiment were stumped in January, 1936, and are now pruned on the Modified Multiple Stem system which is advocated throughout Bugishu District. During the 1937/38 season a small crop of cherry was harvested with no significant differences between treatments.

(2) *1932 planted Cultural Experiment at Bugusege.*(a) *Results.*—

*Yields: Tons Wet Cherry per Acre.*

|                                         | Clean Weeded. | 2 Cover Crops. | Banana Mulch. | Weed Cover. | Oct.-March Cover Crop. | March-Oct. Cover Crop. | Shade. |
|-----------------------------------------|---------------|----------------|---------------|-------------|------------------------|------------------------|--------|
| Total for seasons 1934/35 to 1936/37 .. | 3.98          | 2.72           | 7.80          | 1.41        | 6.37                   | 7.82                   | 4.49   |
| Season 1937/38 ..                       | 4.26          | 2.18           | 4.45          | 1.77        | 2.20                   | 3.45                   | 3.02   |
| Total for four seasons ..               | 8.24          | 4.90           | 12.25         | 3.18        | 8.57                   | 11.27                  | 7.51   |

The least significant difference between treatments is 2.00 tons per acre.

(b) *Conclusions.*—During the 1937–38 season the Banana Mulch, March to October cover crop, and Clean Weeded treatments were best and equal. Over the four seasons that the experiment has now been running the Banana Mulch treatment has given the highest yields.

The Clean Weeded plots are showing serious signs of erosion, although this is not yet reflected in the yields. Two cover crops a year and weed cover are the lowest in yield. During the past two seasons liquoring tests on coffee from the weed cover plots have shown the coffee to possess a "Uganda" or "grassy" flavour.

The whole of the experiment suffered badly from "die-back" during the year under review, and a number of deaths occurred. Deaths were fewest in the shade plots, and highest in the Banana Mulch plots.

(3) *1936 planted Cultural Experiment at Bugusege.*

This has not yet come into bearing.

(4) *1927 planted Pruning Experiment at Bugusege.*

(a) *Results.*—

*Yields: Tons Wet Cherry per Acre.*

|                                            | Single Stem. | Multiple Stem. | Agobiada. |
|--------------------------------------------|--------------|----------------|-----------|
| Total for seasons 1929/30 to 1936/37 .. .. | 12.40        | 17.71          | 23.56     |
| Season 1937/38 .. ..                       | 0.42         | 2.26           | 2.01      |
| Total for nine seasons .. ..               | 12.82        | 19.97          | 25.57     |

The least significant difference between pruning totals is 1.90 tons per acre.

(b) *Conclusions.*—For the 2nd, 3rd, 4th and 6th years of bearing, Agobiada was superior to Multiple Stem. During the last three seasons these two treatments have been equal, although, in the aggregate, Agobiada still retains its superiority. The Single Stem plots have suffered many deaths which have not been replaced, as it is considered that these have been due to the effect of treatments. During the 1937/38 season the Agobiada treatments produced the same amount of "A" size beans as the Multiple Stem treatments, which is the reverse of what occurred during the previous three seasons.

(5) *1930 planted Pruning Experiment at Bugusege.*

(a) *Results.*—

*Yields: Tons Wet Cherry per Acre.*

|                                            | Natural Growth. | Agobiada. | Modified Multiple Stem. |
|--------------------------------------------|-----------------|-----------|-------------------------|
| Total for seasons 1932/33 to 1936/37 .. .. | 3.72            | 2.71      | 6.28                    |
| Season 1937/38 .. ..                       | 2.93            | 3.29      | 3.21                    |
| Total for six seasons .. ..                | 6.65            | 6.00      | 9.49                    |

The least significant difference between treatments is 0.91 tons per acre.

(b) *Conclusions.*—During the 1937/38 season there were no significant differences between treatments. In the aggregate, however, Modified Multiple Stem still retains its superiority over Agobiada and

Single Stem which are equal. The Natural Growth trees are now in very bad condition with a thicket of branches which furnish a breeding place for *Antestia*, and with much whippy wood in the lower zone. The middle zone suffered badly from "die-back".

(6) *1932 planted Spacing and Pruning Experiment at Bugusege.*

(a) *Results.*—

*Yields: Tons Wet Cherry per Acre.*

| Pruning.       |                | Season.                                    | 8'×8' | 7'×7' | 6'×6' | 4'×4' |
|----------------|----------------|--------------------------------------------|-------|-------|-------|-------|
| Natural Growth | ..             | Total for seasons 1934/35 to 1936/37 .. .. | 3.28  | 3.50  | 4.90  | 8.69  |
|                |                | Season 1937/38 .. ..                       | 3.39  | 3.31  | 3.63  | 3.80  |
|                |                | Total for four seasons ..                  | 6.67  | 6.81  | 8.53  | 12.49 |
| Modified Stem  | Multiple .. .. | Total for seasons 1934/35 to 1936/37 .. .. | 3.42  | 4.44  | 5.87  | 7.24  |
|                |                | Season 1937/38 .. ..                       | 4.33  | 4.32  | 4.36  | 5.03  |
|                |                | Total for four seasons ..                  | 7.75  | 8.76  | 10.23 | 12.27 |

(b) *Conclusions.*—Natural Growth was superior to Modified Multiple Stem during the first cropping season, the next year they were equal, and in the past two seasons Modified Multiple Stem has been superior, as it is also in the aggregate.

As regards spacing, the closer spacings were superior during the first three seasons, but this season all are equal. The totals for all seasons show that 4 ft.×4 ft. spacing still yields the heaviest crops, followed by 6 ft.×6 ft., which is in turn superior to 7 ft.×7 ft. and 8 ft.×8 ft. which are equal. The Natural Growth trees are now in very bad condition and also produce smaller proportions of "A" size beans as determined by grading out-turn tests.

(7) *1936 planted Spacing, Uprooting and Stumping Experiment at Bugusege.*

This has not yet come into bearing.

(8) *1932 planted Artificial Shade Experiment at Bugusege.*

The maintenance of the system of artificial shade was found to be too complicated at a district experiment station of this nature and the experiment has now been abandoned. A simple experiment with artificial shade will be substituted.

Details of the lay-out of experiments at Bugusege may be found in Part II of the Annual Reports for the year ended 31st December, 1935, and the year ended 30th June, 1937.

(9) *Variety Trial at Bududa.*

The varieties are detailed in the Annual Report, Part II, for the year ended 30th June, 1937. The trial was planted in August, 1936, and trees have not yet come into bearing. Gaps were refilled during 1937.

(10) *Shade Demonstration Plots at Bubulu.*

The trees were in process of being changed over to two different Multiple Stem systems of pruning, and no yields are available.

(11) *Observation Plots at Bubulu.*

The yields in pounds of wet cherry per plot from small experimental plots (unreplicated) at Bubulu are given:—

*Yields.*

| Treatment.                              | For the two seasons ended 30/6/37. | 1937/38 season. | Totals. |
|-----------------------------------------|------------------------------------|-----------------|---------|
| Mulched. Dug in December and June .. .. | 1,560                              | 1,917           | 3,477   |
| Mulched. Dug in December only ..        | 1,777                              | 2,716           | 4,493   |
| October to March Cover Crop ..          | 1,912                              | 1,285           | 3,197   |
| March to October Cover Crop ..          | 1,642                              | 1,812           | 3,454   |
| Sprayed with Bordeaux Mixture ..        | ..                                 | 920             | 920     |
| Unsprayed with Bordeaux Mixture .. ..   | ..                                 | 659             | 659     |

*Conclusions.*—Only digging in of mulch in December still retains its advantages over digging in twice yearly.

The March to October cover crop resulted in higher yields of cherry, as at Bugusege, but die-back was more severe on this plot than on the October to March cover crop plot.

A definite advantage can be recorded for the season in using Bordeaux Mixture as a spray.

(12) *Observation Plots at Various Altitudes.*

At seven centres at varying altitudes, observation plots of six varieties of *Arabica* coffee are maintained. These were planted in 1936.

(13) *Manuring and Liquoring Quality.*

Liquoring tests were carried out on coffee from farmyard manured and clean weeded plots, and indicated that manuring had had no adverse effect on liquoring qualities.

**D. Tobacco.**

Tobacco is grown in Bunyoro, West Nile and Ankole Districts. Observation plots are maintained in Toro and Kigezi Districts, at Wanyange in Busoga District and in Samia County of Budama District. The plots at Wanyange were spoiled by hail in September and October, but the leaf from Samia County received favourable reports from the Tobacco Officer, although the crop was affected to some extent by hail and dry weather.



## E. Sesame.

*Variety Trial at Ngetta.*

Seven local varieties of sesame grown in a Latin Square at Ngetta yielded as follows:—

| Variety.                     |    | Yield from 7 plots (in Lbs.). |
|------------------------------|----|-------------------------------|
| No. 5                        | .. | 6.9                           |
| No. 6                        | .. | 10.3                          |
| No. 8                        | .. | 9.7                           |
| No. 10                       | .. | 7.7                           |
| No. 11                       | .. | 7.0                           |
| No. 12                       | .. | 9.4                           |
| No. 13                       | .. | 3.8                           |
| Least significant difference |    | 4.1                           |

*Result.*—Variety No. 13 yields less than varieties Nos. 6, 8 and 12.

## F. Millet.

(1) *Observation Plots of Eleusine at Ngetta.*

Eleven varieties of *Eleusine coracana* grown in single plots of equal size for observation purposes yielded as follows:—

| Variety. |    |    | Time to Maturity (days). | Yield<br>(lbs. unthreshed per acre). |
|----------|----|----|--------------------------|--------------------------------------|
| Odiero   | .. | .. | 121                      | 3,138                                |
| Emoit    | .. | .. | 121                      | 3,245                                |
| Adeyo    | .. | .. | 119                      | 1,992                                |
| Oyoka    | .. | .. | 121                      | 2,775                                |
| Okwang   | .. | .. | 110                      | 2,331                                |
| Apuch    | .. | .. | 116                      | 1,767                                |
| Asagala  | .. | .. | 121                      | 1,952                                |
| Achoma   | .. | .. | 116                      | 1,420                                |
| Oding    | .. | .. | 110                      | 1,597                                |
| Ediera   | .. | .. | 121                      | 2,001                                |
| Okama    | .. | .. | 110                      | 2,041                                |

(2) *Sorghum Variety Trial at Katakwe.*

Ten local varieties of Sorghum were grown in a replicated trial, but no significant differences were demonstrated.

## G. Cassava.

(1) *Effect of Mosaic on Yield in Teso District.*

An experiment designed to determine the reduction in yield of fresh tubers by using Mosaic infected stocks for planting material was carried out at Kumi and Abela in Teso District. The average yields in pounds per plant are shown below:—

| Centre.  | From diseased stock. | From healthy stock. |
|----------|----------------------|---------------------|
| Kumi ..  | 2.65 pounds.         | 5.55 pounds.        |
| Abela .. | 6.24 pounds.         | 6.42 pounds.        |

The Kumi results further confirm the conclusions formed from similar experiments conducted in Teso District during 1936. No importance can,

however, be placed on the Abela results, as many tubers were stolen before harvesting was done.

(2) *Variety Trials in Teso District.*

Variety trials of two imported types and three local varieties were planted at two centres in Teso District during May, 1937. The object of these trials is to select a variety for distribution in Teso District that yields heavily as well as being palatable. Many of the imported varieties tried previously have not been liked locally as food.

## H. Soil Conservation.

(1) *Anti-Erosion at Bukalasa.*

All cultivated plots have now been contour bunded and erosion has been completely checked. In any case no erosion can take place in the first year after elephant grass fallow but as the vegetable matter decays rapidly bunds are essential in the second and third years.

(2) *Regeneration with Elephant Grass at Bukalasa.*

Investigations into the best method of planting elephant grass have continued and without doubt the most satisfactory is the planting of roots. Seed has been tried as being the cheapest method, but germination is very irregular and this method is not entirely satisfactory. Cuttings are liable to dry out if the weather is dry for sometime after planting, but are cheaper and easier to plant than roots.

The satisfactory yields of cotton and other crops on the main experimental area afford abundant proof of the value of elephant grass fallow. That these yields have been maintained in the second year after opening up is very satisfactory.

A considerable amount of the work on elephant grass has been done by Makerere students studying at Bukalasa in their fourth and fifth years. This work has been done very well and great credit is due to those students who assisted.

(3) *Grass Regeneration Experiment at Kumi.*

This was described in the 1936 Annual Report, Part II.

Of the grasses under trial *Chloris Gayana* has made the best cover. *Cynodon plectostachyum* has nearly died out and has given way to *Eragrostis superba*, *Chloris Gayana* and other grasses. *Imperata cylindrica* has been difficult to establish. *Pennisetum purpureum* has made a fair stand and is growing well.

(4) *Regeneration Experiment at Kamuge.*

*Objects.*—To investigate the relative value of cassava and natural grass cover as a resting period.

*Lay-out.*—Ten 1/20th acre plots under cassava, and ten 1/20th acre plots under grass, randomized in pairs. The cassava will be harvested at the beginning of 1938, and an index crop of cotton grown in all plots.

(5) *Elephant Grass Rotation Experiment at Bukalasa.*

*Lay-out.*—Three periods of resting under elephant grass—two, three and four years with a fourth treatment in which the land is allowed

to revert to bush for three years; in all four cases after three years cropping.

This season saw the last crops of the first cycle and all plots will be under fallow next season, so at this stage a summary of the yields to date is of interest:—

*Yields in lbs. per acre : Seed Cotton.  
Groundnuts Unshelled.  
Beans Shelled.*

|                                                | A.    | B.    | C.    | D.    |
|------------------------------------------------|-------|-------|-------|-------|
| 1935/36 Cotton .. .. .                         | 405   | 365   | 383   | 300   |
| 1936/37 Groundnuts .. .. .                     | 2,268 | 1,930 | 2,325 | 1,912 |
| Cotton .. .. .                                 | 728   | 733   | 637   | 668   |
| 1937/38 Beans (interplanted in Cotton) .. .. . | 110   | 85    | 68    | 110   |
| Cotton .. .. .                                 | 595   | 568   | 603   | 581   |
| Total weight harvested per acre (lbs.) .. .. . | 4,106 | 3,681 | 4,016 | 3,571 |

All four rotations have been cropped similarly to date, and it will be seen that their uniformity is not entirely satisfactory.

(6) *Tobacco—Cotton—Elephant Grass Rotation Experiment at Bukalasa.*

Three of the four rotations were planted to Elephant Grass while the fourth was under Green Manure followed by Cotton.

(7) *Cotton Manurial Experiment at Bukalasa.*

This experiment began its third cycle, a crop of cotton following the third application of manure and yielding as follows:—

*Seed Cotton (Lbs. per Acre).*

|                                  | No Cotton Seed. | Cotton Seed.<br>4 tons per acre. | Mean. |
|----------------------------------|-----------------|----------------------------------|-------|
| No Green Manure .. .. .          | 585             | 679                              | 632   |
| <i>Crotalaria juncea</i> .. .. . | 603             | 765                              | 684   |
| Mean .. .. .                     | 594             | 722                              | 658   |

Conclusions will be drawn at the end of the cycle.

(8) *Tobacco—Cotton Manurial Experiment at Bukalasa.*

This experiment began a new cycle. Manures were applied again and followed by tobacco, then cotton, yielding as follows:—

| Treatments.                                  | Tobacco<br>(lbs. green leaf per acre). | Seed Cotton<br>(lbs. per acre). |
|----------------------------------------------|----------------------------------------|---------------------------------|
| Control .. .. .                              | 1,492                                  | 416                             |
| Cotton Seed (4 tons per acre)                | 2,108                                  | 472                             |
| Cotton Seed Ash (5 cwt.<br>per acre) .. .. . | 2,032                                  | 484                             |
| Kraal Manure (10 tons per<br>acre .. .. .    | 2,560                                  | 492                             |

Conclusions will be drawn at the end of the cycle.



(9) *Pastures at Ngetta.*

The main objects of the work on pasture plants at Ngetta were defined in Part II of the Annual Report 1937. There has been no extension of the work in the interim, but observations on grasses and pastures were continued.

Grazing records to determine the carrying capacity of the pastures were unfortunately discontinued for a part of 1937 during a change-over in the management of the farm, but the figures which exist indicate no reason to doubt that something over one ox per acre can be supported throughout the year and that during the rainy months the carrying capacity of the pastures is as much as 2.5 oxen per acre.

Observations as to the optimum intensity of grazing were continued. No definite conclusions have been reached so far but the indications are that very close grazing tends to the spread of *Cynodon dactylon* at the expense of the other grasses. This in itself does not appear to detract from the carrying capacity of the pastures but may constitute a disadvantage later when the land is brought under cultivation again. Up to the present the indications are that withdrawal of the cattle while there is still a knee-high cover is more advantageous than close grazing.

In the matter of the optimum time to commence grazing it has been found that pastures left ungrazed until the grasses are well established, *i.e.*, for a period of from six to seven months from the date on which they were seeded down, tend to produce a closer cover than pastures grazed in the early stages. The weeding of pastures in the initial stages has been found to be disadvantageous and all weeding of pastures has been discontinued at Ngetta. In the ordinary way the weeds are suppressed by the grasses in the first year and their presence in the initial stages before the grasses are established constitutes a useful soil cover and arrests erosion.

Observations on a large number of grasses were continued during the year. Salient points emerging from these observations are that *Brachiaria Kotschyana* and *Paspalum notatum* are of little value at Ngetta because of their inability to withstand the dry season. *Chloris Gayana*, *Hyparrhenia filipendula* and *Brachiaria decumbens* are the most promising grasses tried so far. All three are easily propagated, readily eaten by stock and produce a good amount of herbage. *H. filipendula* possesses the disadvantage, however, that it is sensitive to close grazing and may die out altogether if over-grazed.

Under Ngetta conditions it is now established that *Pennisetum polystachyon*, which is the first grass to become established in the normal succession after cultivation in large tracts of Lango and Acholi, is useful in a seeds mixture because of its quick growth and the good cover it affords in the early stages of the pasture. It is short-lived, however, and usually dies out in the second year of the pasture.

Imported *Chloris Gayana* of an Australian strain has proved to be unsuitable for Ngetta conditions.



(10) *Model Shamba at Bukalasa.*

It became necessary to instal a new tenant in August as the previous one had become very lazy and difficult to manage. The new one after a satisfactory start has also proved to be lazy and his wife refuses to work with him so that another tenant will have to be found early in the 1938/39 season.

The Economic and Food crop plots (bananas excepted) were banded by hand during the year.

The yields on the economic crop plots were low, groundnuts in particular yielding little more than half the previous crop. The yield of cotton was a little higher than last year and this is probably due to the fact that closer spacing was employed. It is noteworthy that the highest yielding plot of cotton was that after green manure. The profit on the holding shows a slight increase over last year owing to the very much greater yield of coffee.

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